

TMDL Program Five Year Progress Report



Prepared by the Virginia Department of Environmental Quality
in cooperation with the Department of Conservation and Recreation and the
Department of Mines, Minerals, and Energy

January 2005

Table of Contents

Fact sheet on the Five Year Progress Report.....	3
1. Introduction.....	6
2. TMDL Development	7
2.1 Progress.....	7
2.2 Projected Needs	8
3. TMDL Implementation Plan Development.....	10
3.1 Progress.....	10
3.2 Projected Needs	10
4. TMDL Implementation	10
5. TMDL Implementation Case Studies.....	11
5.1 North River Watershed Implementation Case Study.....	12
5.2 Middle Fork Holston River Watershed Implementation Case Study.....	23
5.3 Blackwater River Watershed Implementation Case Study.....	30
5.4 Four Mile Run Watershed Implementation Case Study.....	38
5.5 Middle Creek Watershed Implementation Case Study	41
5.6 Quail Run Watershed Implementation Case Study	42
6. 2004 TMDL Program Summary and Outlook.....	44
Appendix A : Remining and TMDL Implementation Plans	45

Fact sheet on the Five Year Progress Report

TMDL Program Five Year Progress Report

The Virginia Department of Environmental Quality monitors the state's rivers, lakes and tidal waters for pollutants every year to determine if the public can use them for swimming, fishing and drinking. If pollution amounts are too high, the waters cannot support their designated uses and fail to meet Virginia water quality standards. These waters are considered "impaired."

Since 1999, DEQ has developed plans, with public input, to restore and maintain the water quality of the impaired waters. These plans establish a "total maximum daily load," or TMDL, for the impaired waters. A TMDL represents the total amount of a pollutant a water body can contain and still meet water quality standards. DEQ also develops a TMDL implementation plan and works with partners to reduce pollution to the level required by the TMDL.

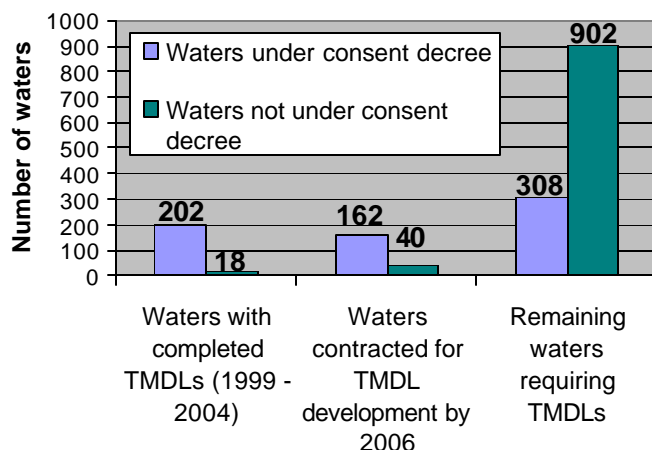
Through a consent order, a federal court established a schedule for TMDL development in Virginia through 2010 for waters identified as impaired since 1998. For other waters, DEQ schedules the development of TMDLs within eight to 12 years of finding the waters impaired. In January 2005, DEQ in cooperation with the Department of Conservation and Recreation and the Department of Mines, Minerals, and Energy released a report that describes the progress of TMDL development, implementation plans and the application of best management practices in Virginia's TMDL program.

Progress and future goals

TMDL development

The Virginia TMDL program has successfully met the demands of a rigorous development schedule. The program completed 220 TMDLs from 1999 to 2004, and more than 200 have been contracted for completion by 2006. Just over 300 consent decree waters remain and are scheduled for TMDL development by 2010. The program has scheduled TMDL development for the remaining 902 non-consent decree waters on the impaired waters list within eight to 12 years of when the water was designated impaired.

Status of TMDL development for impaired waters



To develop a TMDL, the state considers:

- ? Naturally occurring concentrations of pollutants in the impaired waters.
- ? Pollution from fixed locations, such as a pipe or ditch (point sources).
- ? Pollution sources without a single point of origin, such as agricultural activities and urban areas (nonpoint sources).
- ? Seasonal variations.

Implementation plans

Once a TMDL has been completed, it is submitted to the U.S. Environmental Protection Agency for approval. DEQ then develops a TMDL implementation plan. The plan describes ways to reduce pollution levels in the stream, and includes a schedule of actions, costs and monitoring. The TMDL program has completed six implementation plans covering 18 TMDLs and scheduled 16 implementation plans covering 42 TMDLs for completion by 2006. Completion of implementation plans for the 544 consent decree waters and 902 non-consent decree waters will be dependent upon available funding and staff.

Implementation plans		
	Number of plans	Number of TMDLs covered
Completed	6	18
Scheduled	16	42
	Number of consent order waters	Number of non-consent order waters
Remaining	544	902

Best management practices

The program and its partners work to achieve a TMDL by reducing pollution according to the best management practices established in the implementation plan. Best management practices are effective and practical ways to prevent or reduce pollution from nonpoint sources to ensure water quality. They could range from repairing septic systems and establishing storage areas for animal waste to planting vegetation.

The TMDL program has been working in six watersheds, and five have shown improvement in water quality. It is too early in the implementation process to determine if water quality is improving in the sixth watershed. The portion of the watersheds covered by the implementation plans is about 158,663 acres or 248 square miles of Virginia's landscape. In most watersheds, local soil and water conservations districts or the Virginia Department of Conservation and Recreation have taken the lead in overseeing the implementation of the best management practices. To determine the success of the practices on water quality, DEQ monitors the impaired streams.

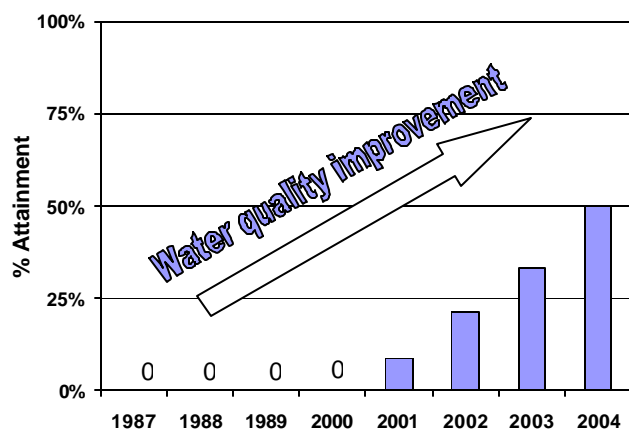
The table below gives an overview of the six watersheds and the progress made in each.

Water quality improvement in six watersheds		
Watershed/ Location of area covered by implementation plan	Pollutant source	Water quality improvement
North River/Rockingham County	Agricultural, non-point	Some improvement
Middle Fork Holston River/Washington County	Agricultural, non-point	Moderate improvement
Blackwater River/Franklin County	Agricultural, non-point	Some improvement
Four Mile Run/Arlington & Fairfax counties	Urban, non-point	Too early to determine
Middle Creek/Tazewell County	Coal mining activities	Definite improvement
Quail Run/ Rockingham County	Point source	Definite improvement

Voluntary efforts have been a key to success in these watersheds. The Middle Creek is a successful example of Virginia's proactive approach to water quality improvement. This approach aims to clean impaired water bodies through voluntary methods in order to avoid the costly and time-consuming process of developing TMDLs and implementation plans. In this watershed, water quality restoration was driven by stakeholder interest or other resource management programs that preceded TMDL completion.

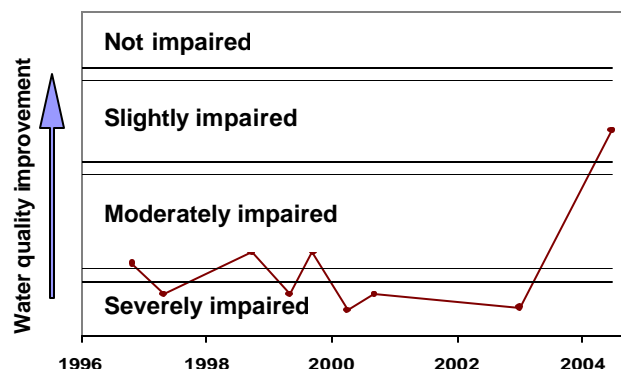
Dozens of voluntary and government-funded best management practices are used throughout the watersheds. For example, there are over 100 best management practices in use in the Middle Fork Holston River watershed that have resulted in water quality improvements. The following diagram illustrates the improving bacteria violation rates in one of the streams located in the Middle Fork Holston River watershed.

Hutton Creek bacteria conditions



In some cases, pollution can be traced to a single point source, as in the Quail Run watershed. In this watershed, water quality restoration was driven by the upgrade of the Massanutten STP. The most recent biological samples collected in fall 2004 show the best results since DEQ began monitoring the stream.

Quail Run biological scores



Funding and future needs

The estimated total cost to develop TMDLs through 2010 is about \$10.7 million. DEQ projects that, assuming level funding sources and accurate estimates, the agency will be able to meet the consent order schedule and complete the development of the TMDLs required by 2010.

Estimated total costs through 2010	
Total costs of consent order TMDLs	\$5,065,000
Total costs of non-consent order TMDLs	\$429,000
Bacteria source tracking costs	\$1,003,200
Staff	\$4,232,500
Total costs for TMDL development	\$10,729,700

There do exist, however, several unknown factors that could pose difficulties in meeting the TMDL schedule. These factors include the quantity of non-consent order waters or impairments included in the TMDL schedule, implementation plan development costs, unforeseen complexities and modeling costs for more complex TMDLs. Challenges also exist in the development of TMDLs for complex pollutants such as mercury, and in the maintenance of a growing TMDL pool with the potential for future TMDL modifications to accommodate permit needs.

A growing challenge for the program is the transition from developing TMDLs to actual water quality improvements. Because there are no new authorities for enforcing TMDLs, it has been Virginia's expectation to implement TMDLs using existing programs and funding sources. Existing resources include permits from DEQ and the Virginia Department of Mines, Mineral and Energy that limit discharges to state waters. These programs are utilized when stream impairments are attributed to a permitted facility. For non-permitted activities, Virginia's approach has been to use incentive-based programs such as the Virginia Agricultural Cost Share Program and the State Revolving Loan Fund. Virginia also offers dedicated funding for the implementation of best management practices in watersheds with approved implementation plans.

Despite the challenges, Virginia's TMDL program has shown that properly applied and maintained best management practices result in measurable improvements in water quality. The information provided in the annual report on Virginia's TMDL program will help to identify strategies that will ensure continued success. The report is available on the DEQ web site at www.deq.virginia.gov/tmdl.

1. Introduction

The goal of Virginia's Total Maximum Daily Load (TMDL) program is to achieve attainment of water quality standards. The Commonwealth achieves this goal by means of a three step process: TMDL development, TMDL Implementation Plan Development, and implementation of best management practices.

TMDLs are required for water bodies that are determined to be impaired. In general, TMDL development is required under Section 303(d) of the Federal Clean Water Act and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR Part 130). The Virginia TMDL program is governed by a federal court order Consent Decree that lays out a schedule for TMDL development through 2010 for waters identified as impaired by 1998. For all other water bodies, TMDL development will be scheduled within 8-12 years of finding the water body impaired.

The TMDL process begins with the development of a TMDL that will result in the attainment of water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL also accounts for seasonal variations and includes a margin of safety.

Once a TMDL has been completed, it is submitted to EPA for approval. Then a TMDL Implementation Plan (IP) is developed. The IP describes the measures that must be taken to reduce pollution levels in the stream, and includes a schedule of actions, costs, and monitoring. Virginia state law (1997 Water Quality Monitoring, Information, and Restoration Act (§62.1- 44.19:4 through 19:8 of the Code of Virginia), or WQMIRA, requires the development of a TMDL IP. The formal development of the IP is dependent upon available funding and staffing. However, IP development through existing resources can begin immediately following the approval of the TMDL.

The third step in the TMDL process is to implement the TMDL and monitor stream water quality to determine if water quality standards are being attained. In general, the Commonwealth intends for the pollutant reductions to be implemented in a staged fashion. Staged implementation is an iterative process that first addresses those sources with the largest impact on water quality. Implementation activities typically begin following the completion of the IP. Implementation through existing resources can, however, be initiated in the interim. Implementation of the waste load allocation portion of the TMDL is initiated by DEQ through the permit process. In general, the permit must be in compliance with the TMDL waste load allocation at the time of permit reissuance following the approval of the TMDL.

TMDL Reports, Implementation Plans and Implementation progress updates are available on DEQ's TMDL website at <http://www.deq.virginia.gov/tmdl>.

Achieving the goal of attainment of water quality standards requires the cooperation of several agencies and groups. These include: USEPA, DEQ, Department of Conservation and Recreation (DCR), Virginia Department of Mines, Minerals, and Energy (DMME), Virginia Department of Health (VDH), Virginia Department of Forestry (DOF), Virginia Cooperative Extension (VCE), Virginia Department of Agriculture and Consumer Services (VDACS), Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts (SWCD), Planning District Commissions (PDCs), local governments, businesses, community watershed groups, and citizens. These agencies provide both technical and financial assistance to ensure the success of the TMDL program. In fact, over the last five years, Virginia has spent an estimated 20 million dollars on TMDL development and

implementation of which approximately 10% has come from state dollars from DEQ, DCR, and DMME.

The following document describes the progress the Commonwealth has made in each step of the TMDL process and discusses the projected needs to continue to move successfully through the TMDL process. The intended purpose of the annual report is to provide an at-a-glance review of TMDL program in Virginia. It is our hope that this document will be used as a tool for future program direction.

2. TMDL Development

2.1 Progress

The tables below provide a summary of the TMDLs that must be completed by 2010 (those under consent decree), newly listed segments requiring TMDLs, and TMDLs that have been completed, delisted, or scheduled for development. There are many ways to summarize the number of TMDLs completed in the Commonwealth; by TMDL report, watershed, segment, assessment unit, TMDL equation, etc. For this report, a TMDL segment is defined as a 'consent decree segment' as defined by the 1999 federal Consent Decree. This is because Commonwealth receives credit from EPA for completed TMDLs based on the segments as defined by the consent decree. Some waters that are not consent decree segments are included in the following tables as well. These waters are specifically labeled as non-consent decree or 'non CD' segments. The numbers for non-consent decree impaired segments were obtained from the Final 2004 305(b)/303(d) Water Quality Assessment Integrated Report and are provided in assessment units.

Table 2.1 Summary of consent decree segments

Total Waters under Consent Decree (CD)	672
Freshwater CD Waters Completed or Delisted in 1999 - 2004	141
Freshwater CD Waters Completed/Contracted for 2006	107
Shellfish CD Waters Completed or Delisted in 2004	61
Shellfish CD Waters Completed/Contracted for 2006	55
Remaining CD Waters to be completed in 2008 and 2010	308

Table 2.2 Freshwater Consent decree (CD) segments completed, delisted, or scheduled for completion

Basin	Total Freshwater CD Segments	Freshwater CD segments with completed TMDLs	Delisted Freshwater CD Segments ^{1,2}	Freshwater CD segments scheduled for 2006
Bay/Coastal	25	0	0	1
Chowan	45	3	3	29
James	93	19	8	8
New	14	7	0	3
Potomac, Shenandoah	101	55	3	18
Rappahannock	30	4	2	11
Roanoke	53	21	4	14
Tennessee, Big Sandy	40	12	3	11
York	24	0	0	12
Total	425	121	23	107

¹ includes 3 partial delists

² includes the Dry River (B21R) temperature delist which does not count toward the allowed consent decree delists

Table 2.3 Shellfish Consent Decree (CD) segments completed, delisted, or scheduled for completion

Basin	Total Shellfish CD Segments	Shellfish CD Segments with completed TMDLs	Shellfish CD Segments – Delists and Closures	Shellfish CD Segments Scheduled for 2005
Bay/Coastal	127	4	30	43
Chowan	0	0	0	0
James	17	0	2	4
New	0	0	0	0
Potomac, Shenandoah	48	9	7	0
Rappahannock	37	0	3	8
Roanoke	0	0	0	0
Tennessee, Big Sandy	0	0	0	0
York	18	0	6	0
Total	247	13	48	55

Table 2.4 Non-consent decree segments with completed TMDLs

Basin	Non-CD Segments with Completed TMDLs	Non-CD Segments with TMDL scheduled to be completed by May 2006	Totals (completed or contracted)
Bay/Coastal	0	0	0
Chowan	0	3	3
James	11	0	11
New	2	0	2
Potomac/Shenandoah	2	9	11
Rappahannock	1	2	3
Roanoke	2	15	17
Tennessee/Big Sandy	0	4	4
York	0	7	7
Total	18	40	58

2.2 Projected Needs

The tables below show the number of TMDLs that the Commonwealth is committed to complete beyond 2006. Consent decree waters must be completed by 2010. Non-consent decree waters will be scheduled for TMDL development within 8 to 10 years of finding the water impaired.

Table 2.5 Remaining consent decree (CD) waters requiring TMDLs by 2010

Basin	Freshwater CD Waters Remaining	Shellfish CD Waters Remaining	Total Waters Remaining
Bay/Coastal	24	50	74
Chowan	11	0	11
James	58	11	69
New	4	0	4
Potomac, Shenandoah	26	32	58
Rappahannock	13	26	39
Roanoke	15	0	15
Tennessee, Big Sandy	14	0	14
York	12	12	24
Total	177	131	308

Table 2.6 Non-consent decree waters requiring TMDLs¹

Basin	Impaired Freshwater Segments, 5A only	Impaired Shellfish Segments, 5B only	Waters Impaired Due to Natural Conditions, 5C only	Waters with Multiple Impairments, 5A, 5B, and/or 5C	Total Non-CD Waters needing TMDLs
Bay/Coastal	43	68	5	3	119
Chowan	46	0	12	0	58
James	162	3	22	6	193
New	52	0	2	1	55
Potomac, Shenandoah	103	34	8	13	158
Rappahannock	20	42	13	7	82
Roanoke	79	0	7	7	93
Tennessee, Big Sandy	98	0	0	0	98
York	30	3	7	6	46
Total	633	150	76	43	902

¹ Numbers obtained from the Final 2004 305(b)/303(d) Water Quality Assessment Integrated Report.

Tables 2.5 and 2.6 show the stream segments that are currently listed as impaired and require TMDLs. In addition to these currently listed segments, the Commonwealth acknowledges that there will be additional needs due to the following:

- Adoption of nutrient criteria (proposed adoption in a tiered approach beginning with the Chesapeake Bay in 2005, freshwater lakes in 2006, and freshwater streams in 2007 – see <http://www.deq.state.va.us/wqs/rule.html> for more information)
- Future monitoring of streams resulting in additional impaired waters listings.

Table 2.7 Estimated Funding Requirements to complete TMDL Development through 2010

Total Costs through 2010	
Total estimated costs for Consent Decree TMDLs	\$5,065,000
Total estimated costs for Non Consent Decree TMDLs added to the 10 year schedule	\$429,000
Bacteria Source Tracking Costs	\$1,003,200
Staff	<u>\$4,232,500</u>
TOTAL COSTS for TMDL Development though 2010	\$10,729,700

The estimated costs provided in Table 2.7 represent median costs. The Commonwealth realizes that the costs for the development of TMDLs for impairments such as temperature, DO, and pH may be reduced if these TMDLs are completed “in-house” by agency staff. In this case, the excess funds will be diverted to TMDLs of increasing complexity, watershed approaches, or implementation plan development.

The dollar figure estimate for non-consent decree TMDLs in Table 2.7 is for those non-consent decree waters that are added to the 10 year consent decree. It does not include an estimate for completing all non-consent decree segments identified in Table 2.6. DEQ estimates that approximately 30 percent of the waters completed during the 10 year schedule will be non-consent decree additions.

DEQ projects that, assuming level funding sources and the estimates included in Table 2.7 are fairly close, the agency will be able to meet the consent decree schedule and complete the development of the TMDLs required by 2010. There do exist, however, several unknown factors that could prove to be problematic in meeting the TMDL schedule. These factors include the quantity of non-consent

decree waters or impairments included in the TMDL schedule, implementation plan development costs, unforeseen complexities, and modeling costs for more complex shellfish TMDLs.

3. TMDL Implementation Plan Development

3.1 Progress

Following the completion and approval of the TMDL the TMDL Implementation Plan (IP) is developed. The following tables provide a summary of the Commonwealth's progress in the development of TMDL IPs.

Table 3.1 Summary of IP Development

Basin	IPs Completed	Number of segments in completed IPs	Number of different impairments in completed IPs	IPs proposed for completion ¹	Number of segments in proposed IPs	Number of different impairments in contracted IPs
Bay/Coastal	0	0	0	0	0	0
Chowan	0	0	0	2	9	1
James	0	0	0	2	2	1
New	0	0	0	2	3	1
Potomac/Shenandoah	4	10	2	4	9	3
Rappahannock	0	0	0	2	7	1
Roanoke	1	4	1	2	8	1
Tennessee/Big Sandy	1	4	1	2	3	2
York	0	0	0	0	0	0
Shellfish	0	0	0	1	2	1
Total	6	18	n/a	16	42	n/a

¹ This includes IPs that have been contracted or proposed for initiation. See <http://www.deq.state.va.us/tmdl/ipsched.html> for the complete schedule.

3.2 Projected Needs

Table 3.2 Segments requiring TMDL IP Development

Basin	CD Waters requiring TMDL IPs	Non-CD Waters requiring TMDL IPs ¹
Bay/Coastal	25	119
Chowan	34	58
James	80	193
New	12	55
Potomac, Shenandoah	75	158
Rappahannock	22	82
Roanoke	38	93
Tennessee, Big Sandy	30	98
York	24	46
Shellfish	197	n/a
Total	537	902

¹ Numbers obtained from the Final 2004 305(b)/303(d) Water Quality Assessment Integrated Report

The demand for TMDL IPs will continue to increase as the number of impaired segments increases. As previously mentioned in section 2.2, the number of impaired segments is expected to increase following the adoption of the nutrient criteria and with additional monitoring of state waters.

4. TMDL Implementation

Successful implementation of the Best Management Practices (BMPs) necessary to achieve water quality standards requires the collaboration of several federal, state, and local groups and programs.

Some of these agencies and groups that provide technical assistance and financial incentive programs that support TMDL implementation and environmental conservation include:

- **EPA §319 funds** – EPA has allocated 319 funds for TMDL activities. The three implementation pilot projects described in section 5 of this report were funded by a 319 grant.
- **Environmental Quality Incentives Program (EQIP)** – EQIP offers financial and technical assistance to farmers to help implement management practices that promote agricultural production and environmental quality. EQIP is a voluntary conservation program. For more information visit <http://www.nrcs.usda.gov/programs/eqip/>.
- **Conservation Reserve Enhancement Program (CREP)** – CREP applies to projects that reduce non-point source pollution from agriculture lands by restoring riparian buffers and wetlands. For more information visit <http://www.dcr.virginia.gov/sw/crep.htm>.
- **Agriculture Best Management Practice Cost-Share and Tax Credit Programs** – These programs provide financial incentives to operators to install specific BMPs that reduce sediment and nutrient runoff and improve water quality. For more information visit <http://www.dcr.virginia.gov/sw/costshar.htm>
- **Virginia Agriculture BMP Low Interest Loan Program** – The low interest rate loans are available to assist with the installation of management practices that reduce the impact of polluted agricultural runoff on Virginia's waters. For more information visit <http://www.deq.virginia.gov/cap/aghome.html>.
- **Conservation Easements** – Conservation easements are designed to protect a specific conservation value such as open space, agriculture, water quality, unique habitat or historic features. For more information visit <http://www.westernvirginialandtrust.org>.
- **Supplemental Environmental Projects** – Supplemental environmental projects are available for environmentally beneficial projects undertaken as partial settlement of an enforcement action. These are typically included as part of a requirement of a consent order. For more information visit <http://www.deq.virginia.gov/enforcement/supp.html>.
- **The Tennessee Valley Authority (TVA)** – TVA is a federal corporation and the nation's largest public power company. TVA's Watershed Teams work with state and local communities to protect shorelines, conserve fisheries, and maintain water quality. For more information visit <http://www.tva.gov>.
- **Urban Planning** – Local governments are important participants in the collaborative effort of TMDL implementation. They are typically involved in ensuring proper maintenance of storm and sanitary sewers, providing information to the public on proactive ways protect water quality, and enforcing MS4 programs.
- **Mining** – The reclamation of abandoned mined lands (AML) is necessary to restore impaired streams in Virginia's coalfields. See Appendix A for more information on remining and TMDL implementation.

5. TMDL Implementation Case Studies

This section of the report provides more detailed information on several of the completed IPs including a summary of the best management practices currently in place and water quality changes over the past 10 years (approximate). The TMDL IP watersheds discussed in this section include North River, Middle Fork Holston River, and Blackwater River which are largely rural watersheds dominated by agricultural non-point source pollution; Four Mile Run which is an urban watershed dominated by urban nonpoint source pollution; Quail Run which is a small rural watershed affected by point source pollution; and Middle Creek which is a rural watershed that is affected by mining activity.

In the following sections, three water quality graphs are provided for the North River, Middle Fork Holston River, Blackwater River and Four Mile Run: bacteria data, moving geometric mean, and

violation rate. The bacteria data graph shows the fecal coliform bacteria data obtained from the particular monitoring station in the watershed. The bolded line on the bacteria data graph indicates the 400 col/100 mL standard for fecal coliform bacteria. The fecal coliform case studies were completed based on the 1,000 col/100 mL standard. On January 15, 2003, the fecal coliform standard was changed to 400 col/100 mL. The moving geometric mean was calculated for each data point as the geometric mean of that point and the 11 previous data points. The moving geometric mean graph assesses the prolonged affect of pulses of bacteria in the watershed and emphasizes the direction of a trend in the data while smoothing out anomalies that can confuse the interpretation. The violation rate graph shows the percentage of samples each year that exceed the 400 col/100 mL standard for fecal coliform. For this report, the bacteria data is presented in terms of fecal coliform because of the large dataset available for fecal coliform. Since *E. coli* is the current bacteria standard in Virginia, the water quality graphs in future reports will be presented in terms of *E. coli*.

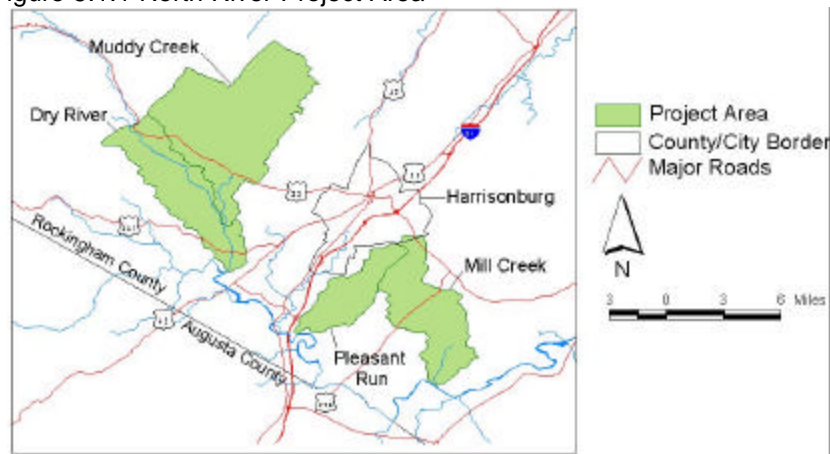
The Best Management Practice data, where available, was provided by the Department of Conservation or the local Soil and Water Conservation District staff.

5.1 North River Watershed Implementation Case Study

5.1.1 Watershed Description

The Lower Dry River, Muddy Creek, Pleasant Run, and Mill Creek drain into the North River located in Rockingham County, Virginia (see Figure 5.1.1). The four watersheds consist of 45,018 acres and the predominant land uses are forest (27%), agriculture (62%), and residential land (11%). The total number of sheep, horses, beef cows, dairy heifers, and dairy cows in the watersheds is 22,808. There are a total of 2,886 residences and businesses in the watersheds with septic systems.

Figure 5.1.1 North River Project Area



5.1.2 Water Quality Impairments

In 1998, the Lower Dry River, Muddy Creek, Pleasant Run, and Mill Creek were placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard, and the Muddy Creek, Pleasant Run, and Mill Creek were listed for violations of the general standard - benthic impairments. The fecal coliform TMDL for Muddy Creek was completed in 1999 and the fecal coliform TMDLs for Dry River, Mill Creek and Pleasant Run were completed in 2001. The benthic TMDLs for Mill Creek and Pleasant Run were completed in 2002 and the benthic TMDL for Muddy Creek was completed in 2003.

5.1.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2001 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years.

The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, land-based nonpoint source load reductions in Muddy Creek and Pleasant Run, and the identification and removal of 6 straight pipes in Muddy Creek conveying human waste to the streams. DCR expanded the eligible BMPs for the Muddy Creek, Pleasant Run and Mill Creek watersheds in late 2003 to include additional practices that would reduce sediment and phosphorus loadings in order to achieve the load reductions in the benthic TMDLs.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.e.*, agriculture, residential and government) and a steering committee.

5.1.4 TMDL Implementation Project

The Shenandoah Valley Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to a five-year implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs in the fall of 2001. Technical assistance funds through 319 were also provided for the SWCD to hire an agricultural conservation specialist and a residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, state assistance has been provided through the Virginia Agricultural Cost-Share Program and the Water Quality Improvement Fund. Additional federal funds have been provided through the Conservation Reserve Program and USDA Environmental Quality Incentive Program. A number of voluntary, non-cost share practices have also been noted and tracked, especially in the Muddy Creek watershed.

Table 5.1.1 provides a summary of the best management practices that were proposed for the North River watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. A more detailed breakdown of the BMPs installed in each subwatershed is included in the next section.

Table 5.1.1 BMP Summary for the North River Watershed

Control Measure	Units	Estimated Units Needed 1	Units Completed 2	Percent Completed
<i>Agriculture Program</i>				
Stream Exclusion Fencing	feet	612,480	30,093	5%
Vegetative Cover on Critical Areas	acres	5,154	876	17%
Forested Riparian Buffer	acres	0	10.3	
Nutrient Management Practices	acres	0	358	
Grassed Waterways	feet	0	4,785	
<i>Residential Program</i>				
Septic System Pump Out	system	0	7	
Septic System Repair	system	10	6	
Sewer Connections	system	0	0	
Septic System Installation	system	17	3	
Alternative Waste Treatment System	system	27	3	
<i>Total On-Site System Installation</i>	system	54	12	22%

1 numbers for septic system installation and alternative waste treatment systems are projected measures to correct 6 straight pipes.

2 the units completed column indicates cost-share and voluntary practices

5.1.5 Best Management Practices and Water Quality Monitoring Data for Stream Segments

As mentioned in the previous section, the local conservation district office took the lead in the oversight of the implementation activities. To gauge the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

The following sections provide more detailed information on the best management practices and water quality data for the major stream segments included in the North River Implementation Plan. These stream segments are Muddy Creek, Pleasant Run, Lower Dry River, and Mill Creek. Where possible, additional watershed information is provided to offer a link between implementation practices and the observed water quality trends. The BMPs were installed as cost-share practices that were partially funded by federal or state programs or voluntarily by the landowner without any cost-share funds.

Muddy Creek

The best management practices listed in Table 5.1.2 were installed in the Muddy Creek watershed from the fall of 2001 through 2004 through cost-share programs. The best management practices listed in Table 5.1.3 were installed voluntarily by the landowner. The number of voluntary BMPs was obtained from the results of a survey distributed by the Shenandoah Valley Soil and Water Conservation District to landowners in the watershed. The District distributed the survey to quantify the voluntary efforts made that were not being accounted for in the traditional tracking of BMP implementation. The date of BMP installation was not documented in the survey and BMPs were reported that were installed prior to 2001.

Table 5.1.2 Cost-share BMPs in Muddy Creek

BMP (Number of Practices)	Units Installed
Grazing Land Protection/Stream Exclusion (4)	4,560 ft
Vegetative Cover on Critical Areas	0
Stream Protection	0
Septic Tank Pump Out	3
Septic System Repairs	3
Septic System Installation	3
Alternative Waste Treatment Systems	1
Forested Riparian Buffer	0

Table 5.1.3 Voluntary BMPs in Muddy Creek

BMP (Number of Practices)	Units Installed
Nutrient Management Practice (8)	224 ac
Stream Fencing	29,598 ft
Cover Crops	876 acres
Animal Waste Storage	31 units
Tree Plantings	3 acres
Dairy Loafing Lots	147 acres
Stream Crossings	14
Grassed Waterways	4,785 ft
Soil Tests	1,012 acres
Pre-Sidedress Nitrate Test	140 acres

Figure 5.1.2 shows fecal coliform concentrations near the outlet of Muddy Creek (at station 1BMDD000.40) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 77% of the time. When comparing data prior to TMDL activities in the watershed (1994-1999) to more recent data (2000-2004), however, the average of the yearly violation rate drops from 84% for 1994-1999 to 63% for 2000-2004.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.3. Yearly violation rates dropped following TMDL activities that began in 1999, however, these rates have rebounded in several years (2002 and 2004). Anecdotal evidence from the watershed suggests that many landowners that initially installed stream exclusion fencing removed the fencing in 2002 to allow cattle access to water during intense drought conditions. Anecdotal evidence also suggests that some exclusion fencing was destroyed by flooding from Hurricane Isabel in the fall of 2003 and flooding from multiple hurricanes in the fall of 2004. It should also be noted that yearly violation rates for the 2001-2004 period are more variable than for the earlier period because fewer samples were collected in these later years. While 12 or more samples were collected in each year from 1994-2000, only 9, 6, 3, and 4 samples were collected in 2001 through 2004, respectively.

The moving geometric mean of fecal coliform concentrations also confirms that fecal coliform levels have decreased since TMDL activities began in 1999, but have been stable or slightly rebounded in more recent years (Figure 5.1.4). The rolling geometric mean was calculated for each data point as the geometric mean of that point and the 11 previous data points. The geometric mean changes through time as new data points are incorporated into the mean and older points are excluded, while always maintaining 12 data points within the averaging window for each mean. An averaging window of 12 data points was selected because it corresponded to the typical number of samples collected over the course of a year. Because means may be biased by changes in the measurement range of the analytical method over time, values were censored to remove this bias. Values were censored using the narrowest measurement range represented in the data set. Any values below 100 cfu/100ml were set to 100 cfu/100ml, and any values above 2000 cfu/100ml were set to 2000 cfu/100ml. Combined evidence from yearly fecal coliform violation rates and from the moving geometric mean of fecal coliform concentrations suggests that water quality in Muddy Creek has improved since initiation of TMDL activities in the watershed.

Figure 5.1.2 Muddy Creek bacteria data, monitoring station 1BMDD000.40

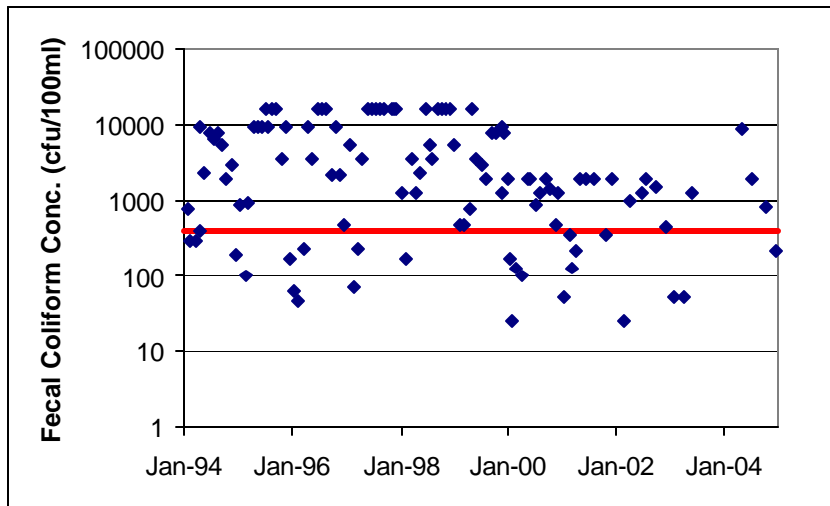


Figure 5.1.3 Muddy Creek violation rate and number of samples collected, monitoring station 1BMDD000.40

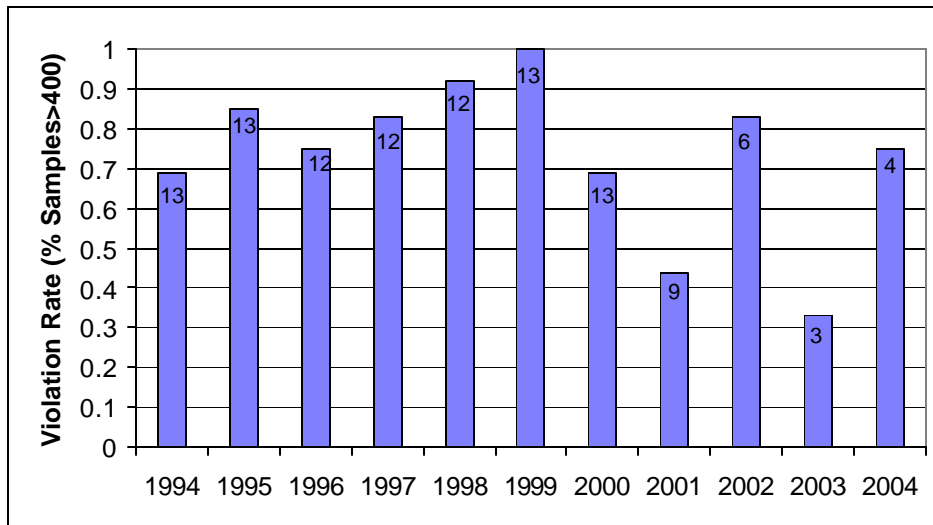
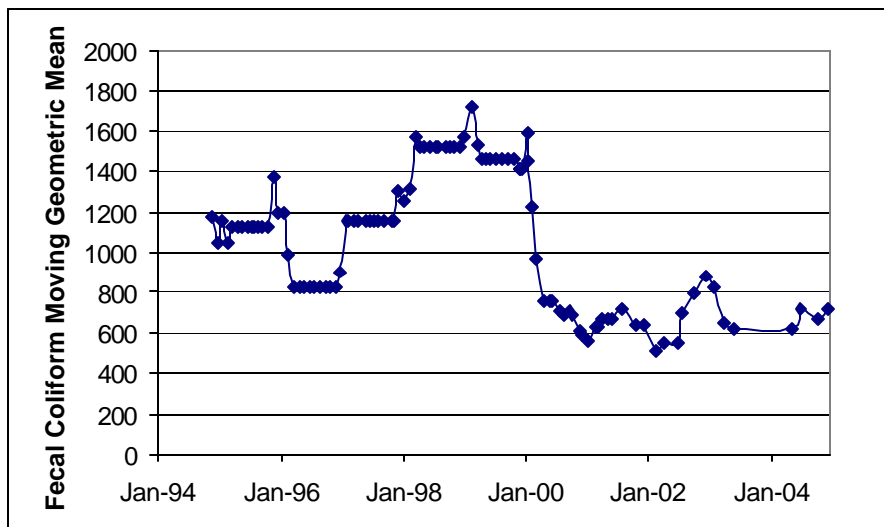


Figure 5.1.4 Muddy Creek moving geometric mean, monitoring station 1BMDD000.40



Pleasant Run

The best management practices listed in Table 5.1.4 were installed in the Pleasant Run watershed from the fall of 2001 through 2004. As previously described, these represent cost share practices. The best management practices listed in Table 5.1.5 were installed voluntarily by the landowners and reported through the previously described survey.

The number and magnitude of BMPs installed in the Pleasant Run watershed is significantly less than for the other watersheds that are a part of the North River TMDL IP.

Table 5.1.4 BMPs in the Pleasant Run watershed

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (4)	1,182 ft
Vegetative Cover on Critical Areas	0
Stream Protection	0
Septic Tank Pump Out	4
Septic System Repairs	1
Septic System Installation	0
Alternative Waste Treatment Systems	0
Forested Riparian Buffer	1.0 ac

Table 5.1.5 Voluntary BMPs in the Pleasant Run watershed

BMP (Number of Practices)	Units Installed
Stream Fencing	2,000 ft
Cover Crops	382 acres
Animal Waste Storage	4 units
Tree Plantings	7 acres
Dairy Loafing Lots	0
Stream Crossings	0
Grassed Waterways	0
Soil Tests	300 acres
Pre-Sidedress Nitrate Test	250 acres
Nutrient Management (4)	n/a

Figure 5.1.5 shows fecal coliform concentrations near the outlet of Pleasant Run (at station 1BPLR000.16) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 94% of the time. No decreasing trend in fecal coliform concentrations is observed since TMDL activities in the watershed began in 2000. In fact, within the past four years, violations rates of the fecal coliform standard have been at 100% (Figure 5.1.6). None of the 22 fecal coliform samples collected in 2001-2004 have met the water quality standard. Moving geometric means of fecal coliform data (Figure 5.1.7), calculated as previously described, also do not show water quality improvements, with the exception of a slight drop in concentrations in 1999 and 2000 that was followed by rebounding concentrations in more recent years. In the Pleasant Run watershed, BMP implementation has not yet been of the magnitude or location to result in measurable water quality improvements at the watershed outlet.

Figure 5.1.5 Pleasant Run bacteria data, monitoring station 1BPLR000.16

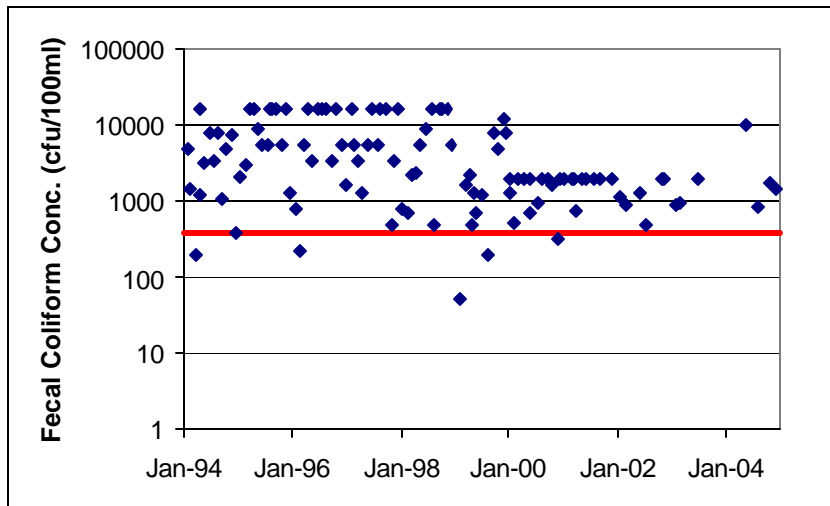


Figure 5.1.6 Pleasant Run violation rate and number of samples collected, monitoring station 1BPLR000.16

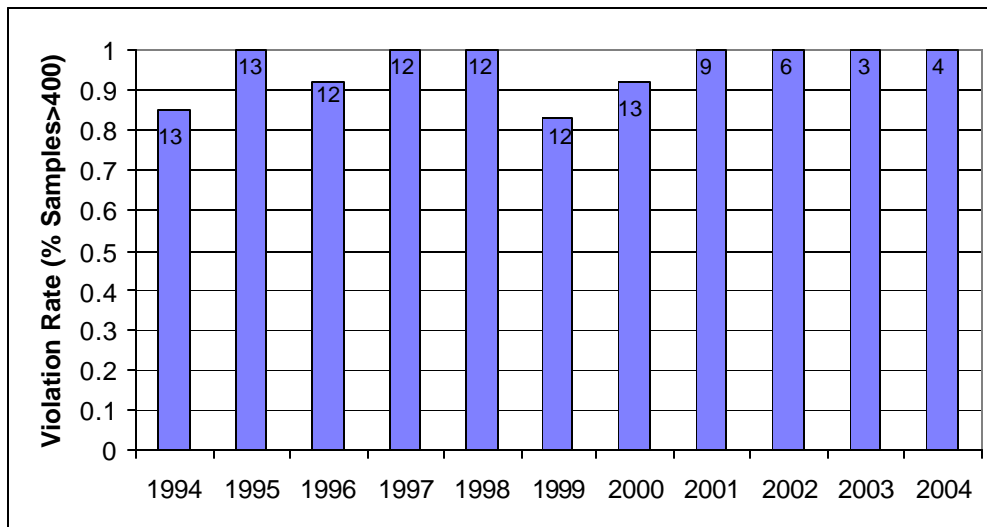
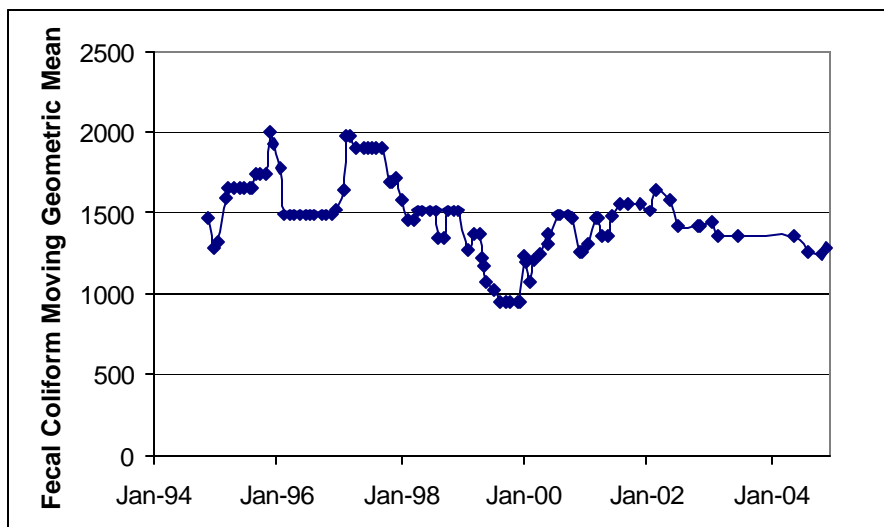


Figure 5.1.7 Pleasant Run moving geometric mean, monitoring station 1BPLR000.16



Lower Dry River

The best management practices listed in Table 5.1.6 were installed in the Lower Dry River watershed from the fall of 2001 through 2004. The best management practices listed in Table 5.1.7 were installed voluntarily by the landowners and reported through the previously described survey. While these BMPs represent only those in the Lower Dry River watershed, water quality improvements in the Lower Dry River will also be influenced by BMPs installed elsewhere throughout the entire Lower Dry River watershed, including Muddy Creek (Table 5.1.2).

Table 5.1.6 BMPs in the Dry River Watershed

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (4)	9,616 ft
Vegetative Cover on Critical Areas	0
Stream Protection	0
Septic Tank Pump Out	0
Septic System Repairs	2
Septic System Installation	0
Alternative Waste Treatment Systems	2
Forested Riparian Buffer	2.9 ac
Nutrient Management Practice (2)	134.6 ac

Table 5.1.7 Voluntary BMPs in the Dry River Watershed

BMP (Number of Practices)	Units Installed
Stream Fencing	14,433 ft
Cover Crops	566 acres
Animal Waste Storage	20 units
Tree Plantings	2 acres
Dairy Loafing Lots	37 acres
Stream Crossings (5)	n/a
Grassed Waterways	2,044 ft
Soil Tests	415 acres
Pre-Sidedress Nitrate Test	100 acres
Nutrient Management (13)	n/a

Figure 5.1.8 shows fecal coliform concentrations near the outlet of Dry River (at Station 1BDUR000.02) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 40% of the time. When comparing data prior to TMDL activities in the watershed (1994-1999) to more recent data (2000-2004), however, the violation rate drops from an average of 49% for 1994-1999 to an average of 20% for 2000-2004. This segment is approaching the 10% violation rate threshold for 303(d) listing of bacteria impairments.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.9. Yearly violation rates have dropped steadily beginning in 1997 to 0% in 2002. In 2002, none of the 6 samples collected exceeded the bacteria standard. Since that time, only 1 sample of 3 collected in 2003 and 1 sample of 5 collected in 2004 exceeded the bacteria standard.

Moving geometric means of fecal coliform data (Figure 5.1.10), calculated as previously described, also confirm the decrease in fecal coliform concentrations beginning in 1997. The rolling geometric mean indicates that fecal coliform concentrations increased dramatically around 1996 and subsequently decreased to pre-1996 levels throughout 1997 and 1998. In approximately 2000 and 2001 fecal coliform levels again decreased to the lowest levels observed in the monitoring period and have remained at approximately those levels since. It is likely that the decreases in fecal coliform levels that were observed in 2000-2001 and sustained since are due to BMP implementation in the Lower Dry River watershed and the Muddy Creek watershed. These watersheds have received the most BMP implementation of the watersheds targeted in the North River TMDL Implementation Plan. It is likely that the dramatic increase and subsequent decrease in fecal coliform levels observed around 1996 were due to other watershed or climactic factors. The year 1996 was the wettest year on record in the watershed, and contained two historic flood events (one in January and one in September). These events undoubtedly altered fecal coliform loading rates and impacted agricultural land uses in the floodplain.

Figure 5.1.8 Lower Dry River bacteria data, monitoring station 1BDUR000.02

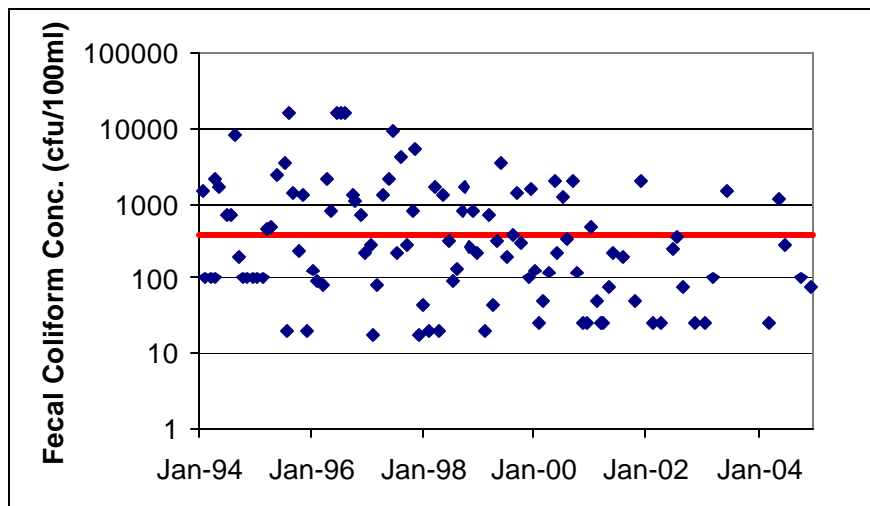


Figure 5.1.9 Lower Dry River violation rate and number of samples collected, monitoring station 1BDUR000.02

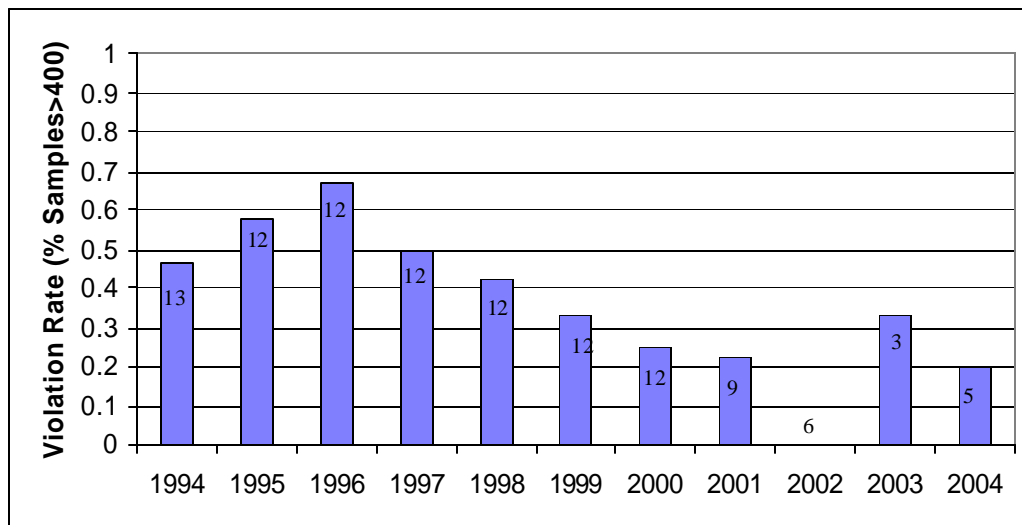
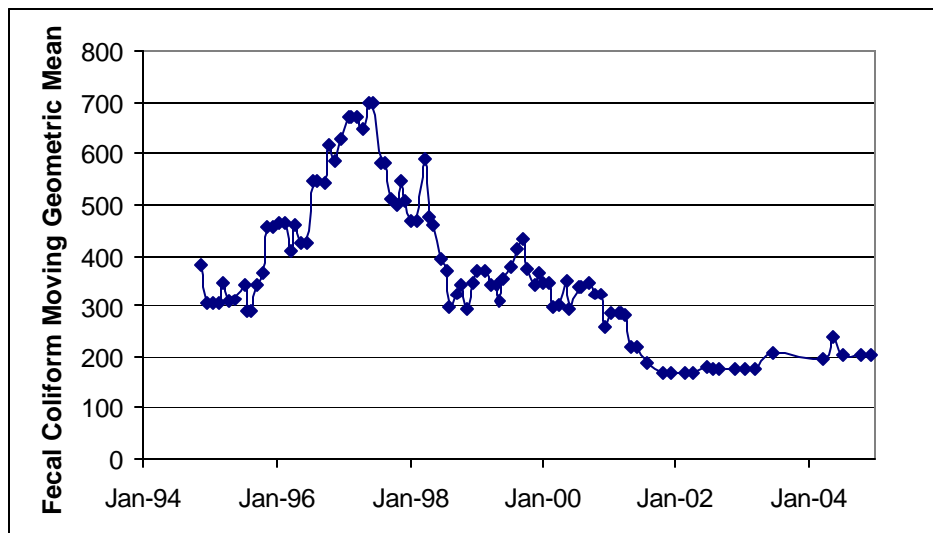


Figure 5.1.10 Dry River moving geometric mean, monitoring station 1BDUR000.02



Mill Creek

The best management practices listed in Table 5.1.8 were installed in the Mill Creek watershed from the fall of 2001 through 2004. The best management practices listed in Table 5.1.9 were installed voluntarily by the landowners and reported through the previously described survey.

Table 5.1.8 BMPs in the Mill Creek Watershed

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (7)	14,735 ft
Vegetative Cover on Cropland (2)	16.4 ac
Reforestation of Critical Areas (2)	25.4 ac
Stream Protection	0
Septic Tank Pump Out	0
Septic System Repairs	0
Septic System Installation	0
Alternative Waste Treatment Systems	0
Forested Riparian Buffer	6.4 ac

Table 5.1.9 Voluntary BMPs in the Mill Creek Watershed

BMP (Number of Practices)	Units Installed
Stream Fencing	500 ft
Cover Crops	65 acres
Animal Waste Storage	1 units
Tree Plantings	1 acre
Dairy Loafing Lots	0
Stream Crossings	0
Grassed Waterways	0
Soil Tests	315 acres
Pre-Sidedress Nitrate Test	0
Nutrient Management (2)	n/a

Figure 5.1.11 shows fecal coliform concentrations near the outlet of Mill Creek (at station 1BMIC001.00) for the past ten years. During this time, fecal coliform concentrations have exceeded the water quality standard 73% of the time. When comparing data prior to TMDL activities in the watershed (1994-2000) to more recent data (2001-2004), however, the average of the yearly violation rates drops from 77% for 1994-2000 to 55% for 2001-2004.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.1.12. Yearly violation rates have dropped steadily since 1999 with the exception of the most recent year (2004). It should be noted that only two samples were collected during 2004, and both of these samples were collected in the heart of the manure application season (3/25/04 and 5/20/04). Additional samples are needed to sufficiently evaluate yearly violation rates in this year.

Moving geometric means of fecal coliform data (Figure 5.1.13), calculated as previously described, also confirm the decrease in fecal coliform concentrations since 1999. The rolling geometric mean indicates that fecal coliform concentrations have continued to steadily decline throughout this period. In this watershed, there have been 7 grazing land protection projects for a total of 14,735 ft of stream protection. In addition, 25.4 acres of highly erodible cropland have been converted to forest and an additional 16.4 acres of cropland converted to permanent vegetation. These practices, in addition to several voluntary efforts, are likely responsible for the continued improvement in water quality in the Mill Creek watershed.

Figure 5.1.11 Mill Creek bacteria data, monitoring station 1BMIC001.00

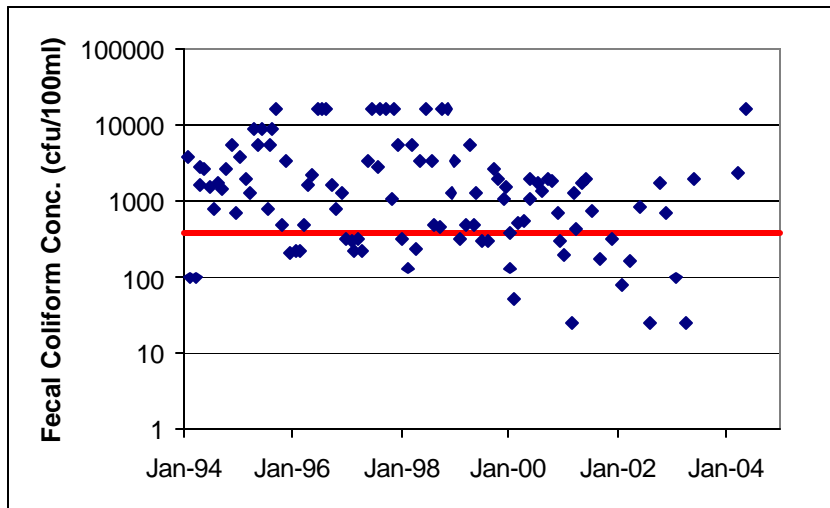


Figure 5.1.12 Mill Creek violation rate and number of samples collected, monitoring station 1BMIC001.00

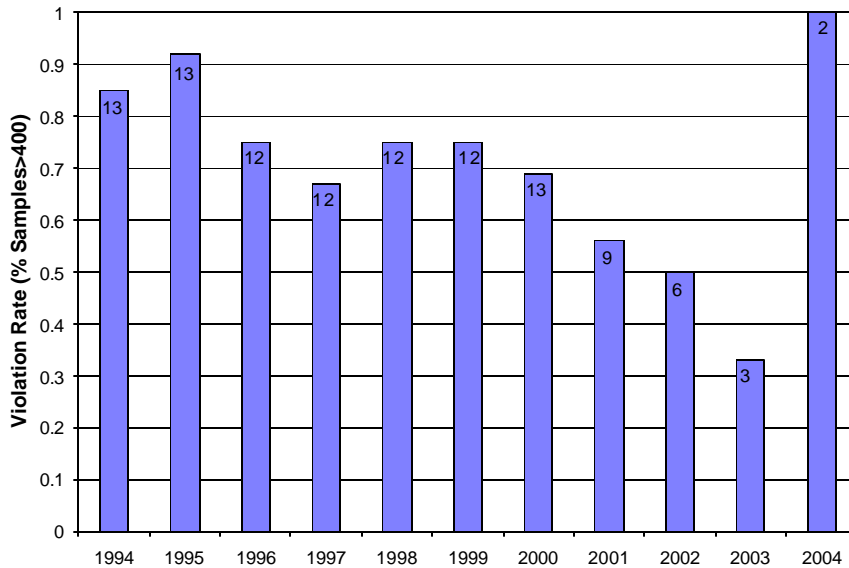
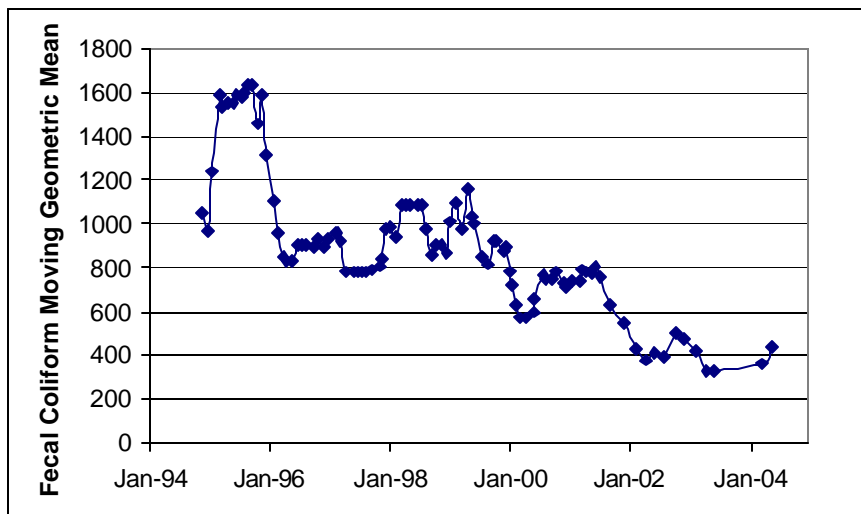


Figure 5.1.13 Mill Creek moving geometric mean, monitoring station 1BMIC001.00

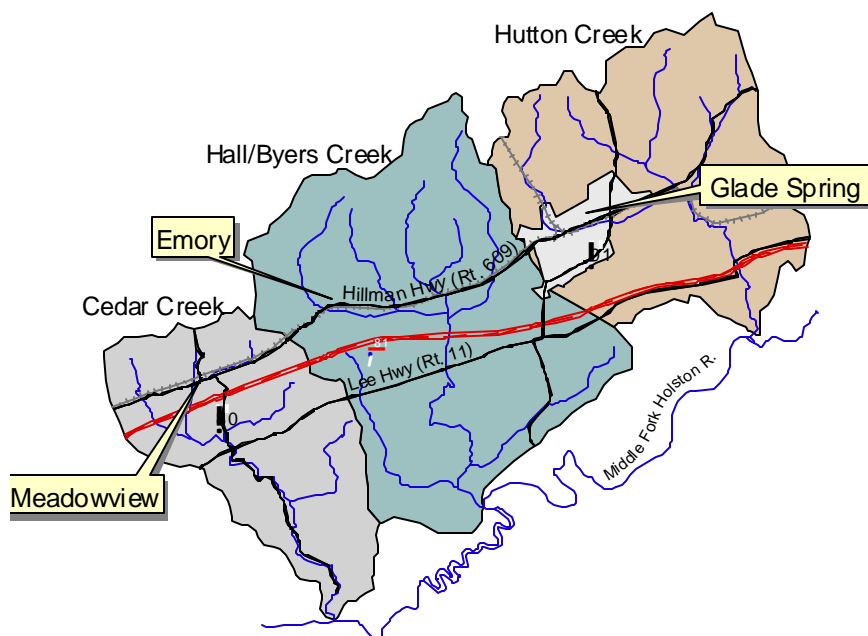


5.2 Middle Fork Holston River Watershed Implementation Case Study

5.2.1 Watershed Description

Cedar, Hall, Byers and Hutton Creeks, which drain to the Middle Fork Holston watershed in the Tennessee/Big Sandy River Basins, are located in Washington County, Virginia, approximately 10 miles east of Abingdon (Figure 5.2.1). The Cedar, Hall, Byers and Hutton Creek watersheds consist of 21,770 acres and the predominant land uses are agriculture (69%), urban and residential land (13%) and forest (18%). The total number of sheep, horses, beef cows, dairy heifers, and dairy cows in the watersheds is 6,590. There are a total of 1,139 residences and businesses in the watersheds with septic systems.

Figure 5.2.1 Cedar, Hall, Byers and Hutton Creek watersheds



5.2.2 Water Quality Impairments

In 1998, Cedar, Hall, Byers and Hutton Creeks were placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard and for general standard, benthic impairments. The fecal coliform TMDLs were completed in 2000 and the benthic TMDLs were approved in 2003.

5.2.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2001 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years.

The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, failing septic systems and straight pipes conveying human waste to the streams must be identified and corrected, along with a 10% reduction of fecal coliform runoff from pasture/hayfields in the Hutton Creek watershed. DCR expanded the eligible BMPs in late 2003 to

include additional practices that would reduce sediment loadings to the impaired streams in order to achieve the sediment reductions in the benthic TMDLs.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.e.*, agriculture, residential and government) and a steering committee.

5.2.4 TMDL Implementation Project

The Holston River Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to a five-year implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs in the fall of 2001. Technical assistance funds through 319 were also provided for the SWCD to hire a full time agricultural conservation specialist and a full time residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, federal and state assistance has been provided through the Conservation Reserve Enhancement Program, federal funds through the USDA Environmental Quality Incentive Program, U.S. Fish and Wildlife Service grant funds, and the Tennessee Valley Authority.

Table 5.2.1 provides a summary of the best management practices that were proposed for the Middle Fork Holston watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. A more detailed breakdown of the BMPs installed in each subwatershed is included in the next section.

Table 5.2.1 BMP Summary for the Middle Fork Holston Watershed

Control Measure	Units	Estimated Units Needed 1	Units Completed	Percent Completed
<i>Agriculture Program</i>				
Stream Exclusion Fencing	feet	205,920	74,791	36%
Vegetative Cover on Critical Areas	acres	0	0	
Forested Riparian Buffer	acres	0	n/a	
<i>Residential Program</i>				
Septic System Pump Out	system	0	120	
Septic System Repair	system	67	9	
Sewer Connections	system	8	2	
Septic System Installation	system	67	4	
Alternative Waste Treatment System	system	67	1	
<i>Total On-Site System Installation & Repairs</i>	system	209	16	8%

¹ numbers for septic system installation, repair, connection to public sewer and alternative waste treatment systems are projected measures to correct 209 straight pipes and failing septic systems.

5.2.5 Best Management Practices and Water Quality Monitoring Data for Stream Segments

As mentioned in the previous section, the local conservation district office took the lead in the oversight of the implementation activities. To gauge the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

The following sections provide more detailed information on the best management practices and water quality data for the major stream segments included in the Middle Fork Holston Implementation Plan. These stream segments are Cedar Creek, Hall/Byers Creek, and Hutton Creek. Where possible, anecdotal watershed information is provided to offer a link between implementation practices and the observed water quality trends.

Cedar Creek

The best management practices listed in Table 5.2.2 were installed in the Cedar Creek watershed from fall 2001 through 2004 through cost-share funds. Figures 5.2.2, 5.2.3, and 5.2.4 show the changes in water quality from monitoring station 6CCED000.14, which is located near the mouth of Cedar Creek.

Table 5.2.2 BMPs in Cedar Creek watershed.

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (13)	22,271 ft
Vegetative Cover on Critical Areas (1)	0.5 ac
Septic Tank Pump Out	41
Septic System Repair	4
Septic System Installation	1
Alternative Waste Treatment System	0
Connection to Public Sewer	1
Forested Riparian Buffer	n/a

Figure 5.2.2 shows fecal coliform concentrations near the outlet of Cedar Creek (at station 6CCED000.14) over the past 15 years. The initial data was collected between 1987 and 1989. All of this data set violated the water quality criteria for fecal coliform bacteria. Between 1989 and 2000, DEQ did not collect water quality samples in this stream. At the beginning of the TMDL study, the stream once again was monitored. Since 2000, DEQ has sampled this stream 49 times. Of those samples, twelve samples met the water quality criteria for bacteria.

Figure 5.2.3 looks at the most recent four years of data by plotting the running geometric mean, calculated as previously described. The overall downward trend indicates that fecal coliform concentrations have declined over time.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.2.4. Yearly violation rates began to decline in 2000 and continued to decline until 2002 (TMDL activities began in 2001). The rates have rebounded in 2003 and then declined again in 2004. While there is no clear explanation for the rebound that occurred in 2003, it is important to note that fewer samples were collected during that year so each sample was more heavily weighted in the analysis. Although this graph indicates that bacteria reduction is still needed in Cedar Creek, as the corrective actions such as livestock exclusion and septic tank pump outs gain momentum, these concentrations should continue to reduce and water quality will improve.

Figure 5.2.2 Cedar Creek bacteria data, monitoring station 6CCED000.14

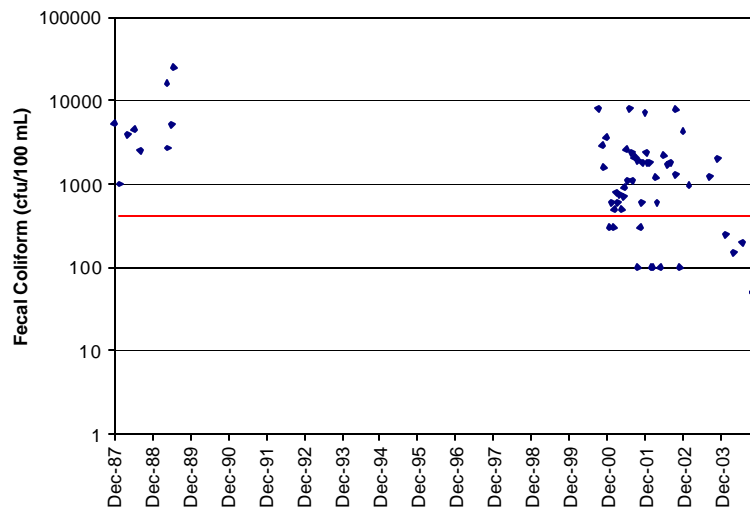


Figure 5.2.3 Cedar Creek moving geometric mean, monitoring station 6CCED000.14

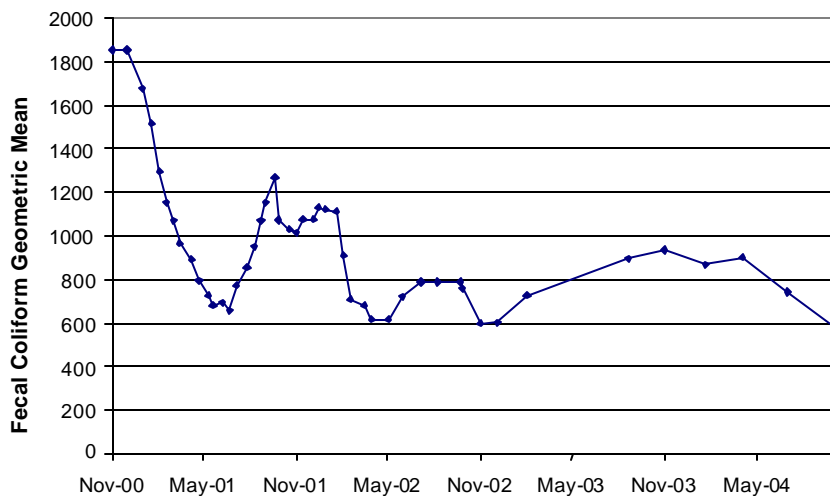
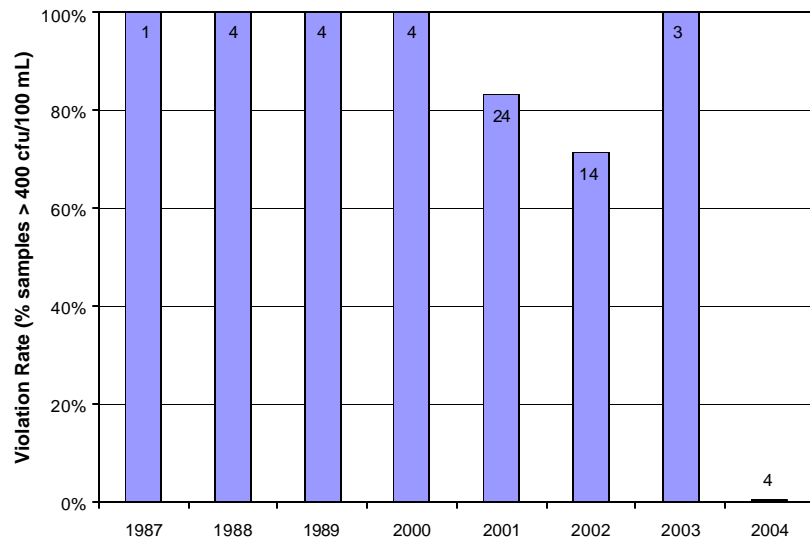


Figure 5.2.4 Cedar Creek violation rate and number of samples collected, monitoring station 6CCED000.14



Hall/Byers Creek

The best management practices listed in Table 5.2.3 were installed in the Hall/Byers Creek watershed from fall 2001 through 2004. Figures 5.2.5, 5.2.6 and 5.2.7 show the changes in water quality monitoring station 6CBYS000.23, which is located near the mouth of Byers Creek.

Table 5.2.3 BMPs in Hall/Byers watershed.

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (15)	24,800 ft
Vegetative Cover on Critical Areas	0
Septic Tank Pump Out	41
Septic System Repair	2
Septic System Installation	1
Alternative Waste Treatment System	0
Connection to Public Sewer	1
Forested Riparian Buffer	n/a

Figure 5.2.5 shows fecal coliform concentrations near the outlet of Byers Creek (at station 6CBYS000.23) over the past 15 years. This data set has a ten to eleven year interval where there is no data. In the Hall/Byers watershed, installation of best management practices to reduce bacteria contributions to the stream actually began before the TMDL study and subsequent implementation plan development. Consequently the violation rate in 2000 was already reduced from 100 percent to less than 70 percent. Since the 2001 implementation plan, corrective actions have increased and many practices that reduce human bacteria contributions as well as practices that focus on reducing livestock bacteria contributions to the stream have been completed. It is important to note that since 2001 many of the data points are below the 400 cfu/100 mL fecal coliform criteria.

Moving geometric means of fecal coliform data (Figure 5.2.6), calculated as previously described, indicates that the fecal coliform concentrations have continued to steadily decline.

Violation rates of the fecal coliform standard are shown for each year in Figure 5.2.7. Yearly violation rates have declined since monitoring resumed in 2000. Although the downward trend is not smooth, Hall Byers Creek exhibited its lowest violation rate in 2004. Anecdotal evidence from the watershed suggests that the decline in 2004 could be attributed to an increase in participation in septic pump-outs and repair during this year, or to the closure of a large dairy farm in early 2004. The implication here is not that the closure of an agricultural facility is improving water quality, but simply that there are high bacteria loadings from both residential and agricultural sources affecting water quality. The Commonwealth recommends best management practices to reduce bacteria loadings.

Figure 5.2.5 Hall/Byers Creek bacteria data, monitoring station 6CBYS000.23

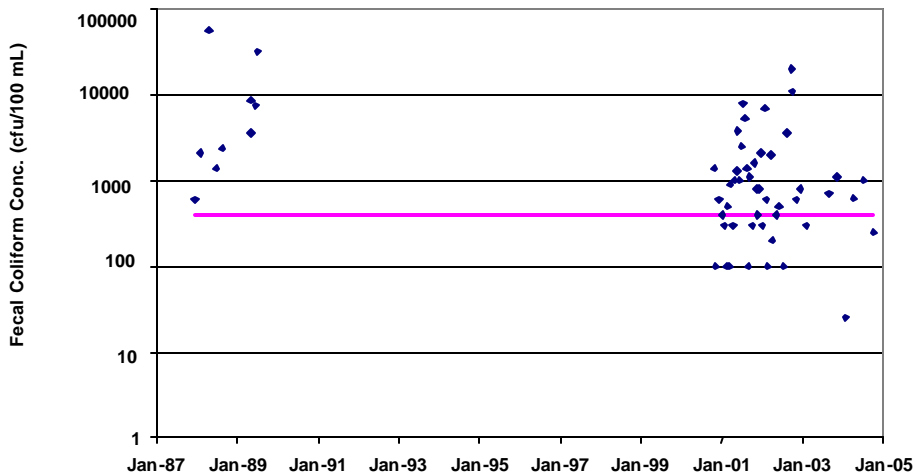


Figure 5.2.6 Hall/Byers Creek moving geometric mean, monitoring station 6CBYS000.23

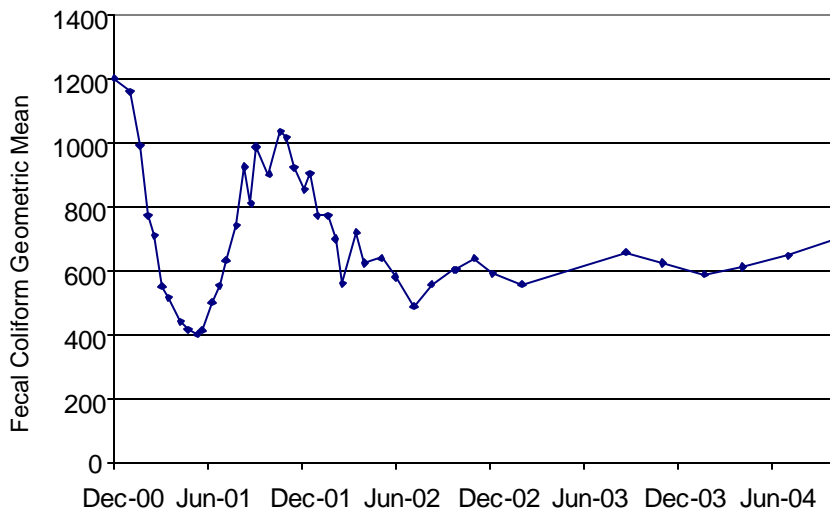
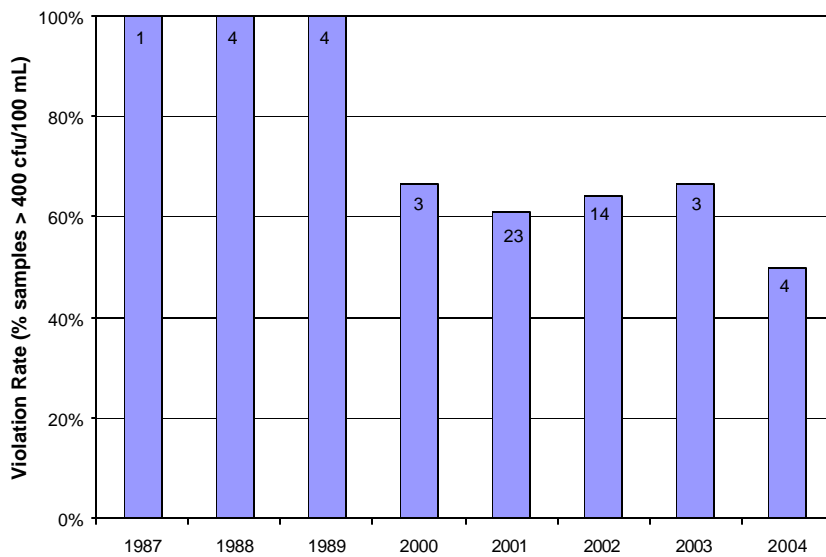


Figure 5.2.7 Hall/Byers Creek violation rates and number of samples collected, monitoring station 6CBYS000.23



Hutton Creek

The best management practices listed in Table 5.2.4 were installed in the Hutton Creek watershed from the fall of 2001 through 2004. Figures 5.2.8, 5.2.9, and 5.2.10 show the changes in water quality from monitoring station 6CHTO000.24, which is located near the mouth of Hutton Creek.

Table 5.2.4 BMPs in Hutton Creek watershed.

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (14)	27,720 ft
Vegetative Cover on Critical Areas	0
Septic Tank Pump Out	38
Septic System Repair	3
Septic System Installation	2
Alternative Waste Treatment System	1
Connection to Public Sewer	0
Forested Riparian Buffer	n/a

Hutton Creek has been the most successful watershed in terms of implementing best management practices that reduce bacteria loading to the stream. As with the other two watersheds, changes in land use practices began to occur soon after the initial data collection and analysis in 1989.

Figure 5.2.8 shows fecal coliform concentrations near the outlet of Hutton Creek (at station 6CHTO000.24) over the past 15 years. Monitoring data is available for 1987 through 1989 and then from 2000 to the present. Moving geometric means of fecal coliform (Figure 5.2.9), calculated as previously described, show an overall downward trend indicating a decrease in fecal coliform concentrations since 2000. This decreasing trend is further demonstrated in Figure 5.2.10 by the steadily declining violation rates beginning in 2001 through 2004.

Figure 5.2.8 Hutton Creek bacteria data, monitoring station 6CHTO000.24

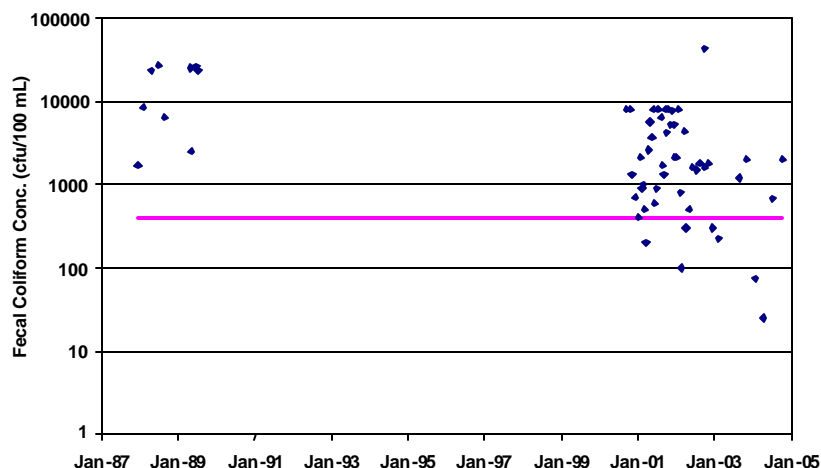


Figure 5.2.9 Hutton Creek moving geometric mean, monitoring station 6CHTO000.24

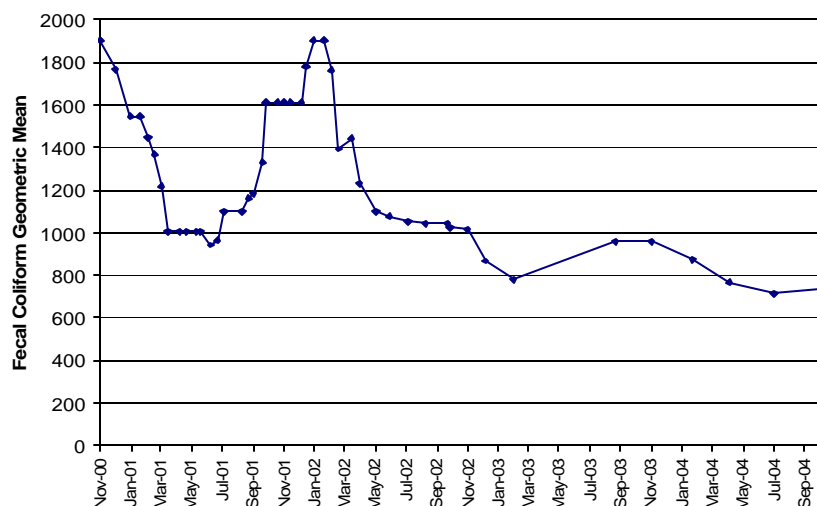
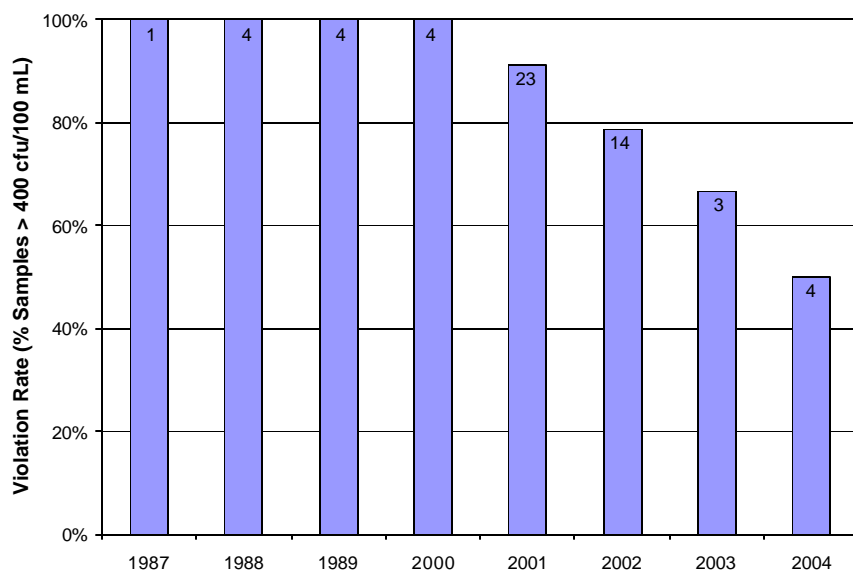


Figure 5.2.10 Hutton Creek violation rate and number of samples collected, monitoring station 6CHTO000.24



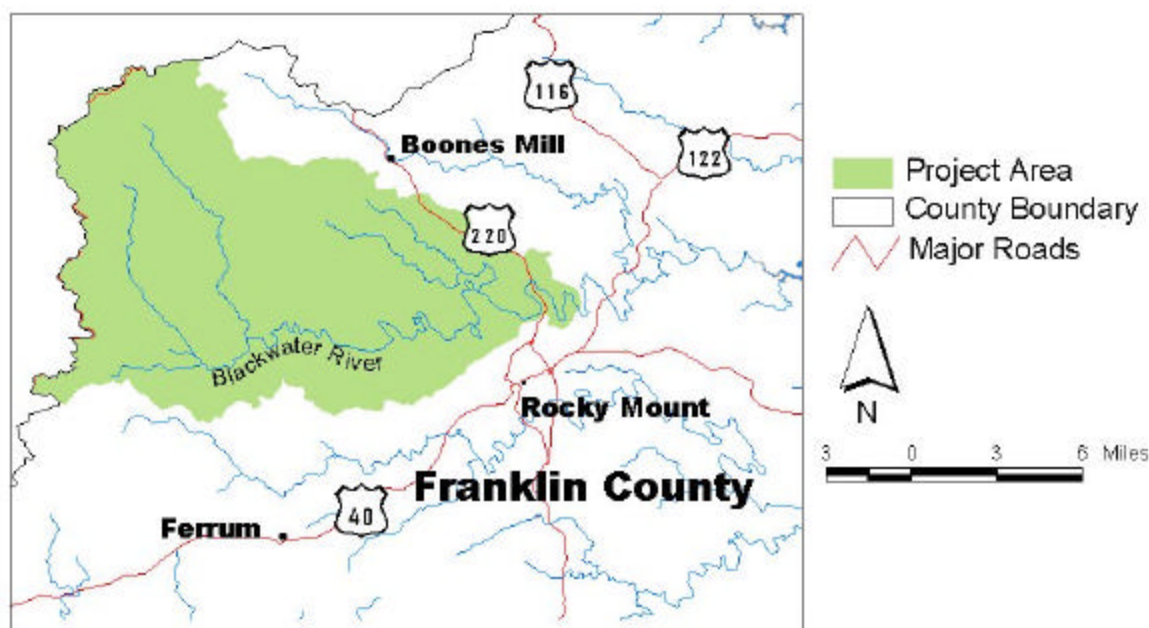
Overall, the Middle Fork Holston watershed shows a decreasing trend in fecal coliform concentrations. Continued monitoring will be needed to establish a statistically significant trend in violation rates and to verify a sustained decrease in fecal coliform concentrations, but initial results show implementation improving water quality.

5.3 Blackwater River Watershed Implementation Case Study

5.3.1 Watershed Description

The North Fork, South Fork, Upper and Middle Blackwater River empty into Smith Mountain Lake, a reservoir in the Roanoke River Basin located in Franklin County, Virginia, south of Roanoke (see Figure 5.3.1). The North Fork, South Fork, Upper and Middle Blackwater River watersheds consist of 70,303 acres and the predominant land uses are forest (64%), agriculture (32%), and residential land (4%). The total number of sheep, horses, beef cows, dairy heifers, and dairy cows in the watersheds is 11,291. There are a total of 2,791 residences and businesses in the watersheds with septic systems.

Figure 5.3.1 Blackwater River Watershed



5.3.2 Water Quality Impairments

In 1998, the North Fork, South Fork, Upper and Middle Blackwater River were placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard, and the North Fork and Upper Blackwater were listed for violations of the general standard - benthic impairments. The fecal coliform TMDLs were completed in 2000 and the benthic TMDLs were approved in 2004.

5.3.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2001 by the Virginia Department of Conservation and Recreation (DCR) and subsequently supported by the EPA with Section 319 funds. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years.

The best management practices (BMPs) identified in the plan included livestock exclusion from streams within all impairments, identification and removal of 15 straight pipes conveying human waste to the streams that must be identified and corrected. DCR expanded the eligible BMPs for the North Fork and Upper Blackwater watersheds in late 2003 to include additional practices that would reduce sediment and phosphorus loadings in the North Fork and sediment loadings in the Upper Blackwater in order to achieve the load reductions in the benthic TMDLs.

During the development of the implementation plan, public participation was encouraged through public meetings, focus groups (*i.e.*, agriculture, residential and government) and a steering committee.

5.3.4 TMDL Implementation Project

The Blue Ridge Soil and Water Conservation District (SWCD) agreed to take on the responsibility of overseeing both the agricultural and residential programs during implementation in accordance to a five-year implementation timeline outlined in the IP. EPA Section 319 funds were allocated by DCR through the Virginia Agricultural Cost-Share Program to implement the agricultural and residential BMPs in the fall of 2001. Technical assistance funds through 319 were also provided for the SWCD to

hire an agricultural conservation specialist and a residential specialist to provide technical assistance to landowners and provide educational/outreach support. In addition to these funds, state assistance has been provided through the Virginia Agricultural Cost-Share Program, Water Quality Improvement Fund and federal funds have been provided through the Conservation Reserve Program and USDA Environmental Quality Incentive Program. Several non-cost share practices have also been noted and tracked.

Table 5.3.1 provides a summary of the best management practices that were proposed for the Blackwater River watershed in the TMDL Implementation Plan report, and includes the BMPs that have been installed to date. A more detailed breakdown of the BMPs installed in each subwatershed is included in the next section.

Table 5.3.1 BMP Summary for the Blackwater River Watershed

Control Measure	Units	Estimated Units Needed ¹	Units Completed	Percent Completed
<i>Agriculture Program</i>				
Stream Exclusion Fencing	feet	369,600	34,561	9%
Vegetative Cover on Critical Areas	acres	0	4.7	
Forested Riparian Buffer	acres	0	5.2	
<i>Residential Program</i>				
Septic System Pump Out	system	0	0	
Septic System Repair	system	0	3	
Sewer Connections	system	0	0	
Septic System Installation	system	7	14	
Alternative Waste Treatment System	system	8	0	
<i>Total On-Site System Installation</i>	system	15	14	93%

¹ numbers for septic system installation and alternative waste treatment systems are projected measures to correct 15 straight pipes.

5.3.5 Best Management Practices and Water Quality Monitoring Data for Stream Segments

As mentioned in the previous section, the local conservation district office took the lead in the oversight of the implementation activities. To gage the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

The following sections provide more detailed information on the best management practices and water quality data for the major stream segments included in the Blackwater River Implementation Plan. Tables 5.3.2 through 5.3.5 include the best management practices for the North Fork, South Fork, Upper, and Middle Blackwater River segments, respectively. Since the DEQ monitoring stations (listing stations) on some of these segments were discontinued, the water quality data has been provided for longer term monitoring stations on the mainstem Blackwater River and Little Creek and Teels Creek (both of which are tributaries of the Middle Blackwater River). The water quality data in the mainstem Blackwater River station (4ABWR045.80) will be influenced by BMPs installed in the North Fork, South Fork, and Upper Blackwater River segments. The water quality data in Teels Creek and Little Creek will be influenced by BMPs installed in the Middle Blackwater River segment.

North Fork of Blackwater River BMPs

The best management practices listed in Table 5.3.2 were installed in the North Fork Blackwater River watershed from the fall of 2001 through 2004.

Table 5.3.2 North Fork of Blackwater River

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (5)	18,757 ft
Vegetative Cover on Critical Areas	0
Stream Protection (1)	1,800 ft
Septic System Repairs	0
Septic System Installation	3
Alternative Waste Treatment Systems	0
Forested Riparian Buffer	5.2 ac

South Fork of Blackwater River BMPs

The best management practices listed in Table 5.3.3 were installed in the South Fork Blackwater River watershed from the fall of 2001 through 2004.

Table 5.3.3 South Fork Blackwater River

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion	0
Vegetative Cover on Critical Areas	0
Stream Protection	0
Septic System Repairs	2
Septic System Installation	2
Alternative Waste Treatment Systems	0
Forested Riparian Buffer	n/a

Upper Blackwater River BMPs

The best management practices listed in Table 5.3.4 were installed in the Upper Blackwater River watershed from the fall of 2001 through 2004.

Table 5.3.4 Upper Blackwater River

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (2)	2,965 ft
Vegetative Cover on Critical Areas	0
Stream Protection (1)	1,800 ft
Septic System Repairs	1
Septic System Installation	2
Alternative Waste Treatment Systems	0
Forested Riparian Buffer	n/a

Middle Blackwater River BMPs

The best management practices listed in Table 5.3.5 were installed in the Middle Blackwater River watershed from the fall of 2001 through 2004.

Table 5.3.5 Middle Blackwater River

BMP & Number of Practices	Units Installed
Grazing Land Protection/Stream Exclusion (2)	6,739 ft
Vegetative Cover on Critical Areas (1)	4.7 ac
Stream Protection (1)	2,500 ft
Septic Tank Pump Out	0
Septic System Repairs	0
Septic System Installation	7
Alternative Waste Treatment Systems	0
Forested Riparian Buffer	n/a

Mainstem Blackwater River Water Quality Data

The data below shows the changes in water quality in the mainstem of the Blackwater River. As previously mentioned, the water quality data for the mainstem Blackwater River monitoring station (4ABWR045.80) will be influenced by BMPs installed in the North Fork, South Fork, and Upper Blackwater River segments (Tables 5.3.2, 5.3.3, and 5.3.4).

Figure 5.3.2 shows fecal coliform concentrations for the past 10 years at station 4ABWR045.80, which is located on the mainstem of the Blackwater River just above the confluence of the Blackwater River and Little Creek. Violation rates of the fecal coliform standard at station 4ABWR045.80 are shown for each year in Figure 5.3.3. Figure 5.3.4 shows the moving geometric mean of fecal coliform concentrations.

Figure 5.3.2 Mainstem Blackwater River bacteria data, monitoring station 4ABWR045.80

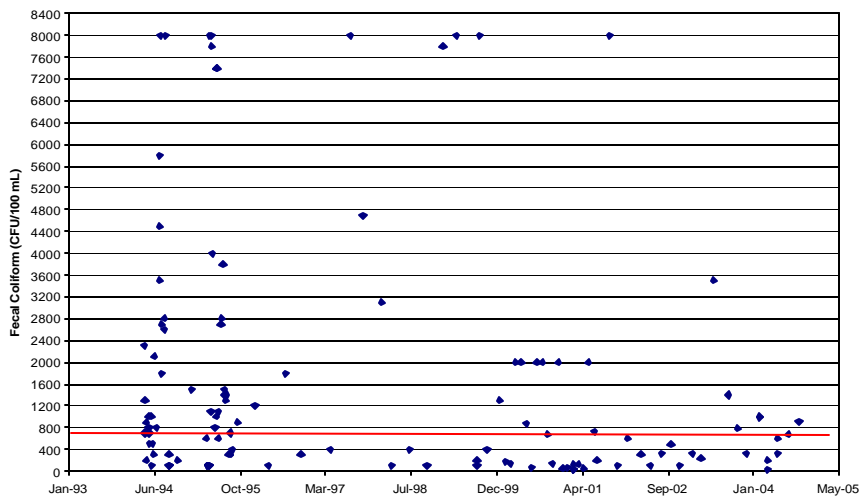


Figure 5.3.3 Mainstem Blackwater River moving geometric mean, monitoring station 4ABWR045.80

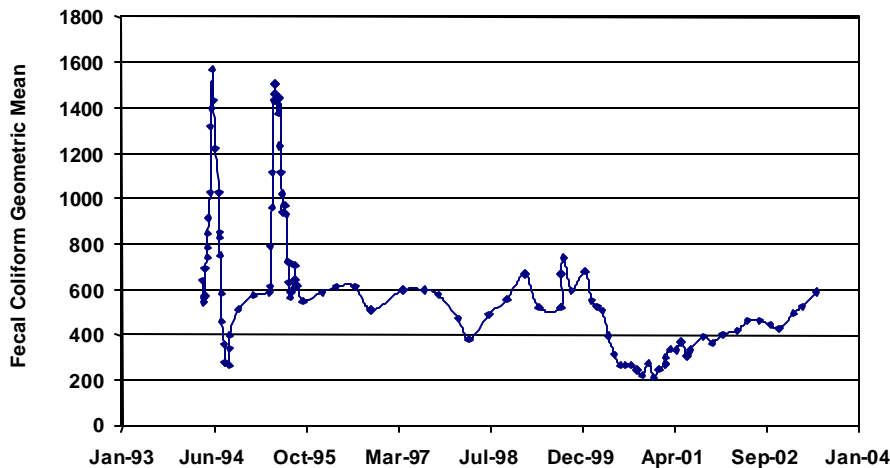
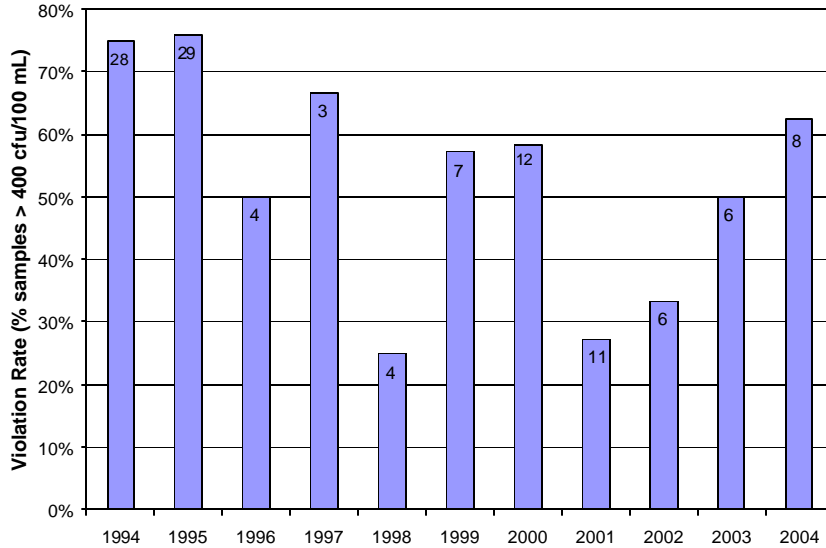


Figure 5.3.4 Mainstem Blackwater River violation rate and number of samples collected, monitoring station 4ABWR045.80



Teels Creek Water Quality Data

The data below shows the changes in water quality in Teels Creek. Teels Creek is a tributary to Little Creek, which eventually flows into the Blackwater River. As previously mentioned, the water quality data for the Teels Creek monitoring station (4ATEL001.02) will be influenced by BMPs installed in the Middle Blackwater River (Table 5.3.5).

Figure 5.3.5 shows fecal coliform concentrations for the past 10 years at station 4ATEL001.02, which is located near the mouth of Teels Creek, just upstream of the confluence with Little Creek. Violation rates of the fecal coliform standard at station 4ATEL001.02 are shown for each year in Figure 5.3.6. Figure 5.3.7 shows the moving geometric mean of fecal coliform concentrations.

Figure 5.3.5 Teels Creek bacteria data, monitoring station 4ATEL001.02

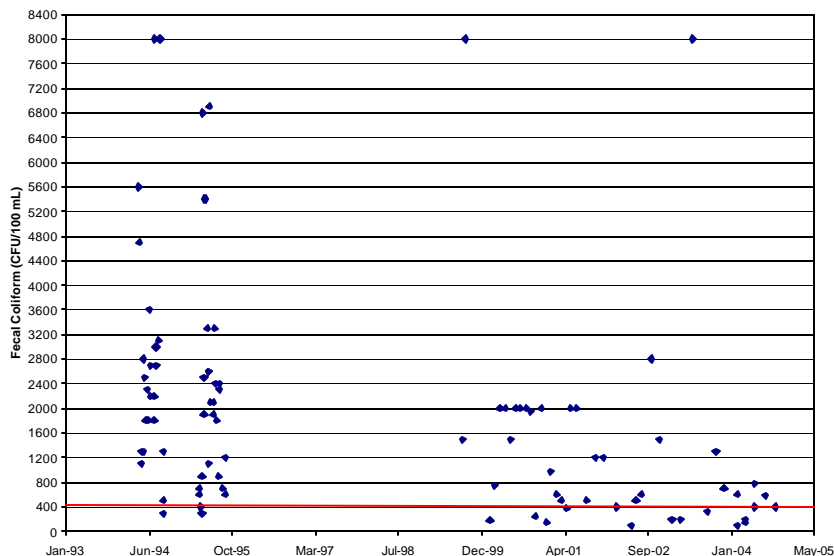


Figure 5.3.6 Teels Creek moving geometric mean, monitoring station 4ATEL001.02

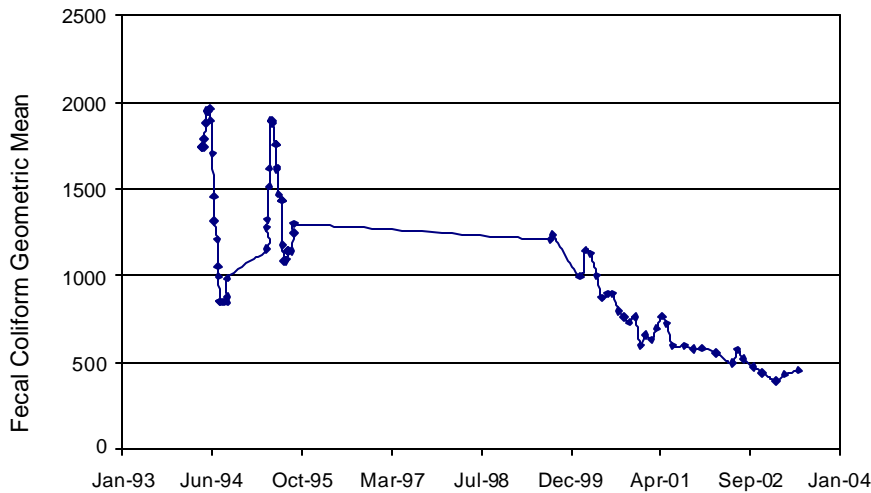
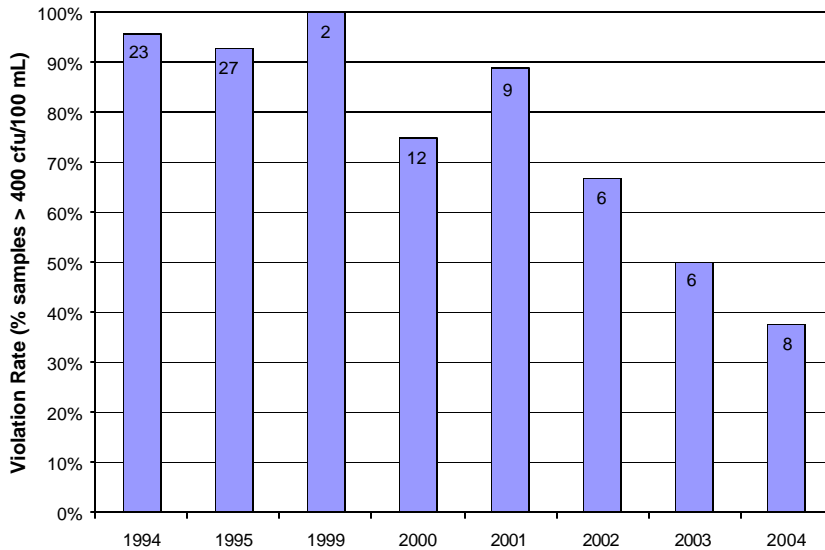


Figure 5.3.7 Teels Creek violation rate and number of samples collected, monitoring station 4ATEL001.02



Little Creek Water Quality Data

The data below shows the changes in water quality in Little Creek. Little Creek is a tributary to the Blackwater River. As previously mentioned, the water quality data for the Little Creek monitoring station (4ALEE005.22) will be influenced by BMPs installed in the Middle Blackwater River (Table 5.3.5).

Figure 5.3.8 shows fecal coliform concentrations for the past 10 years at station 4ALEE005.22, which is located just upstream of the confluence with Teels Creek. Violation rates of the fecal coliform standard at station 4ALEE005.22 are shown for each year in Figure 5.3.9. Figure 5.3.10 shows the moving geometric mean of fecal coliform concentrations.

Figure 5.3.8 Little Creek bacteria data, monitoring station 4ALEE005.22

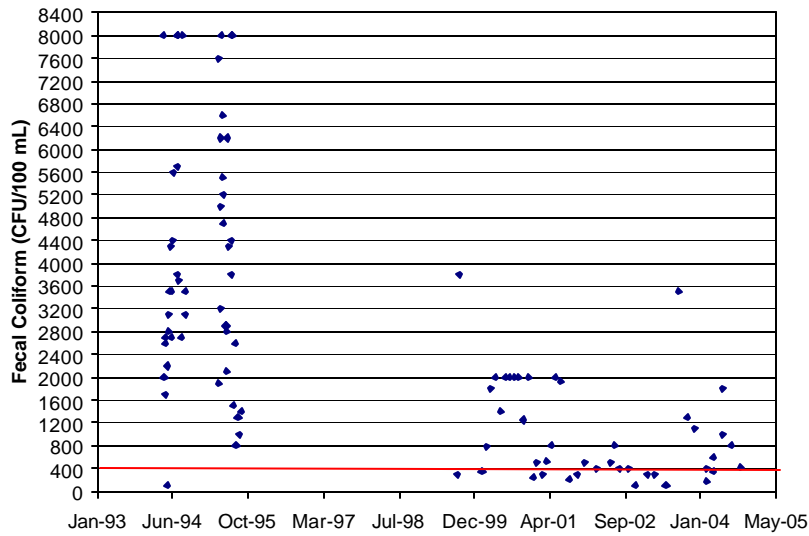


Figure 5.3.9 Little Creek moving geometric mean, monitoring station 4ALEE005.22

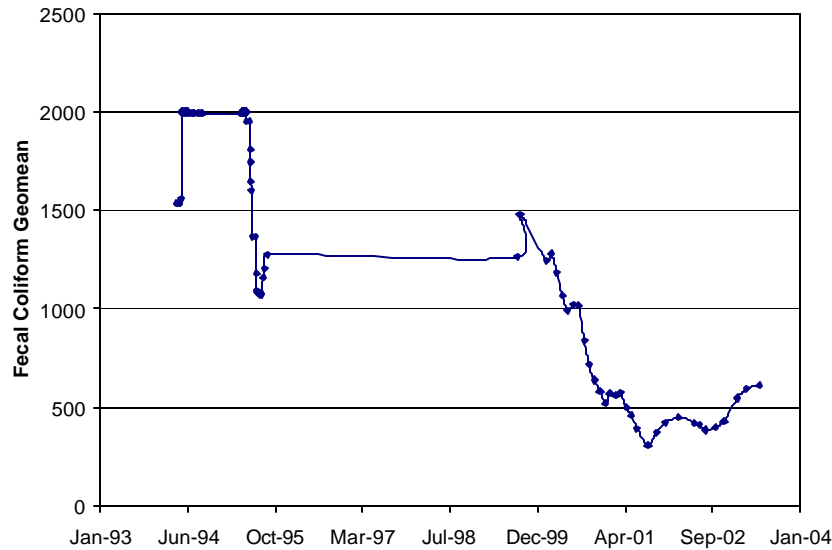
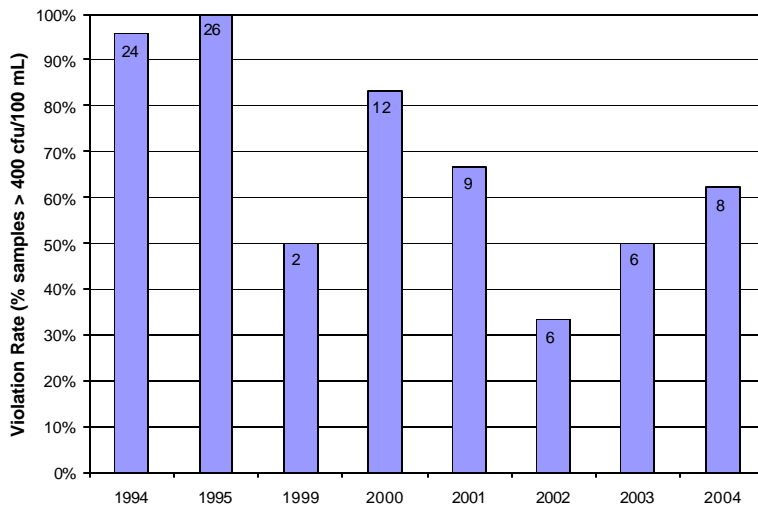


Figure 5.3.10 Little Creek violation rate and number of samples collected, monitoring station 4ALEE005.22



Linking Water Quality Improvement and BMPs in the Blackwater River Watershed

The Blue Ridge Soil and Water Conservation District (BRSWCD) in cooperation with DCR and DEQ has worked to reduce non-point source pollution from agricultural sources for many years. Table 5.3.1 summarizes the BMPs installed during the IP process. The following list sums up watershed management activities over the last ten years that directly correlate to improved water quality.

- 1) BMPs have been installed on many farms in the Blackwater River watershed. Since 1990 EQIP has cost shared \$500,000 worth of projects in the Blackwater River watershed. WQIA monies through a Ferrum College grant (with technical assistance from BRSWCD) completed \$200,000 worth of BMP projects in the mid-1990s. These BMPs included streamside fencing, riparian restoration, hardened stream crossings, and alternative water supplies.
- 2) Dairy farms prior to the mid-1990s were scrap and haul operations which meant that many of the manure stacks were uncovered. In the last 5 years, 20 dairy farmers have installed waste holding systems. This includes parlor water containment. The new waste holding systems have greatly reduced the amount of stormwater runoff from manure stacks and there by reducing bacteria and nutrient inputs into the Blackwater River.
- 3) In 1990, only 15 farms had farm conservation plans (which are required to receive federal funding) even fewer had nutrient management plans. Today nearly 100% of the dairies have conservation plans and 50% have nutrient management plans. These nutrient management plans have help eliminate over fertilization of nitrogen.

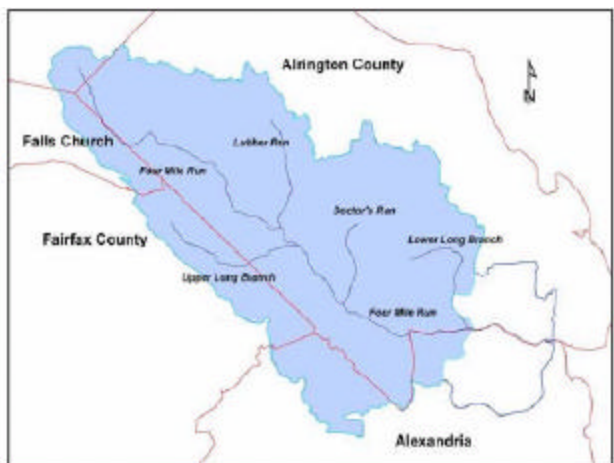
The DEQ trend station in the Blackwater River showed that from 1979 until 1995 bacteria concentrations were increasing significantly. Recent trend analysis from 1979 until 2003 now shows that bacteria concentrations are no longer significantly increasing. Figures 5.3.6, and 5.3.9 displaying the moving geometric validate this recent trend in the Blackwater River watershed. Continued monitoring will be needed to verify a sustained decrease in fecal coliform concentrations.

5.4 Four Mile Run Watershed Implementation Case Study

5.4.1 Watershed Description

Four Mile Run is an urban stream located in Arlington and Fairfax counties and the cities of Alexandria and Falls Church (Figure 5.4.1). Four Mile Run is a direct tributary of the Potomac River which eventually drains into the Chesapeake Bay. The portion of the watershed covered by the TMDL Implementation Plan is approximately 17 square miles.

Figure 5.4.1 Four Mile Run watershed



5.4.2 Water Quality Impairments

In 1998, Four Mile Run was placed on the Virginia 303(d) List of Impaired Waters for violations of the fecal coliform water quality standard. The source of impairment was identified as urban nonpoint source runoff. There is no agricultural runoff in the watershed. The fecal coliform TMDL for Four Mile Run was completed in 2002.

5.4.3 TMDL Implementation Plan

A TMDL implementation plan (IP) was developed in 2004 by DEQ under contract with the Northern Virginia Regional Commission. The IP goal is to achieve the pollutant reductions for bacteria as required by the TMDLs and restore these waters to fully supporting the water quality standards within six to ten years.

The sources of fecal coliform bacteria identified in the IP as requiring reductions are human sources, including leaking sewer lines and illicit sewer connections, dog waste, and wildlife waste.

During the development of the implementation plan, public participation was encouraged through public meetings and technical advisory committee meetings.

5.4.4 Best Management Practices and Water Quality Monitoring Data for Stream Segments

The implementation effort in Four Mile Run is the result of the collaboration of several municipalities and agencies including the Northern Virginia Regional Commission, Northern Virginia Regional Park Authority, City of Alexandria, City of Falls Church, Arlington County, Fairfax County, Virginia Department of Transportation (VDOT), DEQ, and DCR. To gauge the success of the implementation, DEQ monitors the impaired streams through the agency's ambient monitoring program.

Since the completion of the TMDL IP in 2004, the municipalities have made good progress in the implementation of urban BMPs including the inspection and repair of sanitary and storm sewers, enforcing the Chesapeake Bay Act and MS4 programs, inspecting and repairing stream crossings, and taking steps to inform the public of the link between pet waste and water quality. The entire document showing the implementation progress in the Four Mile Run watershed is available at <http://www.deq.virginia.gov/tmdl/pdf/4mileip.pdf>.

The following figures show the water quality data for two stations in the Four Mile Run watershed. Station 1AFOU004.22 was sampled through June 2001, and station 1AFOU001.92 was sampled from May 2002 to present. Figure 5.4.2 shows fecal coliform concentrations in Four Mile Run at stations 1AFOU004.22 and 1AFOU001.92 for the past ten years. Moving geometric means of fecal coliform data is provided in Figure 5.4.3. At this time there is no clear trend in the geometric mean data. The violation rate data is provided in Figure 5.4.4. In 2002, only one sample was collected from the newly established monitoring station (1AFOU001.92). While this sample was below the standard, it is not representative of the annual bacteria concentrations in the watershed. The violation rates do, however, show a decrease from 66% violations in 2003 to 33% in 2004 following the initiation of the implementation activities.

There is no specific information available to explain the lower values shown in the tables for the years 1997 and 1998. After reviewing the USGS flow record for water years 1997, 1998 and 1999, it would appear that samples collected during calendar years 1997 and 1998 were all collected during flows below the annual mean flow for the respective monitoring years.

Figure 5.4.2 Four Mile Run bacteria data, monitoring stations 1AFOU001.92 and 1AFOU004.22

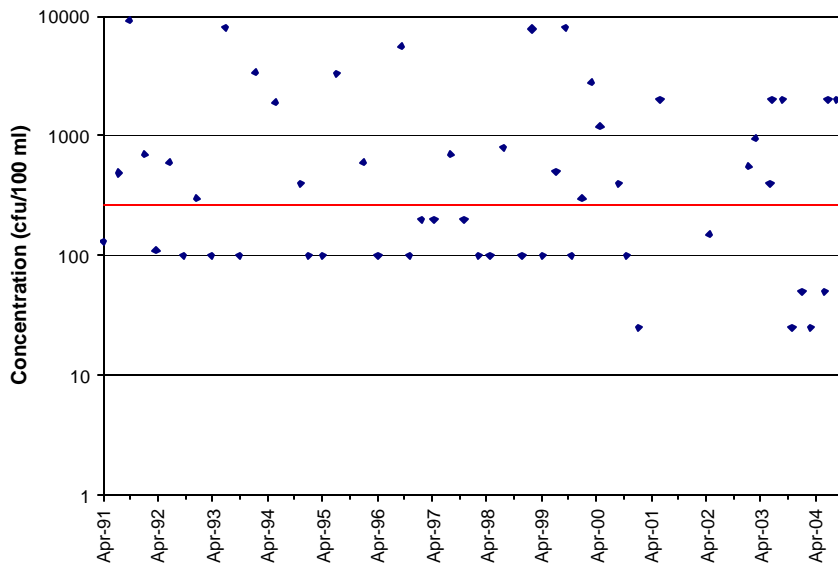


Figure 5.4.3 Four Mile Run moving geometric mean, monitoring stations 1AFOU001.92 and 1AFOU004.22

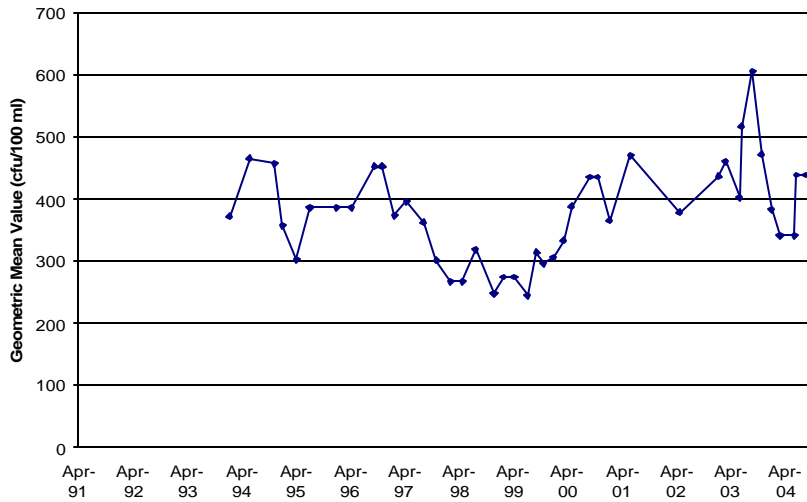
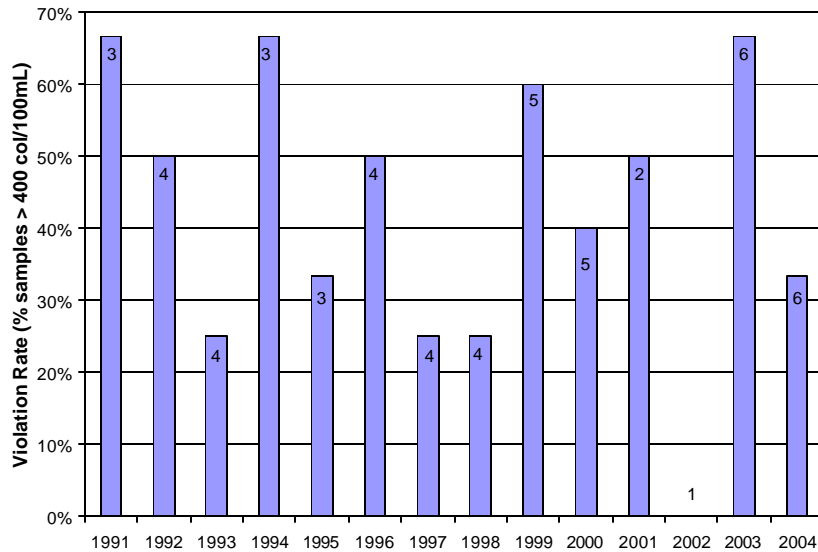


Figure 5.4.4 Four Mile Run violation rate and number of samples collected, stations 1AFOU001.92 and 1AFOU004.22



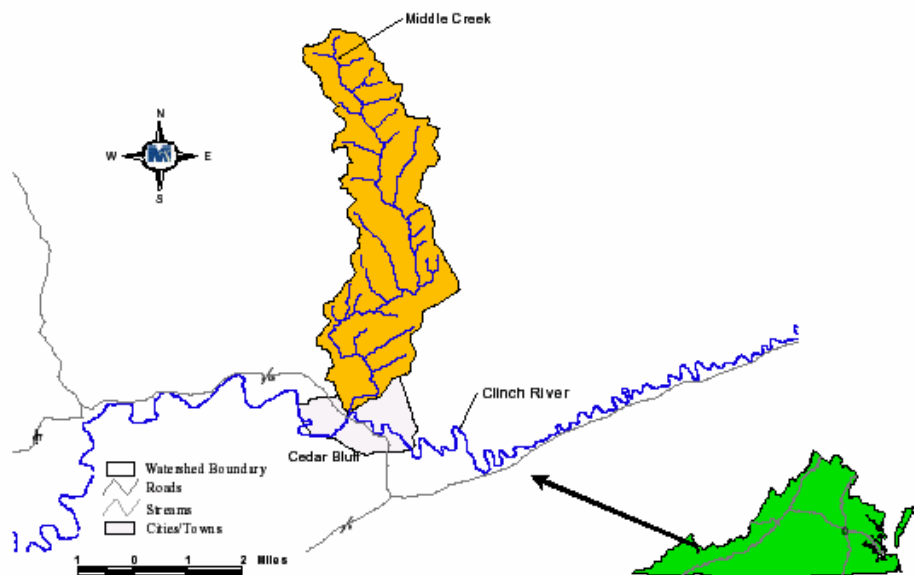
Data suggests that since the initiation of the implementation activities in 2004 water quality conditions in the Four Mile Run watershed are improving. It is too soon, however, to make any true correlation between the implementation activities and water quality improvements. Continued monitoring is needed to verify a sustained decrease in fecal coliform concentrations.

5.5 Middle Creek Watershed Implementation Case Study

The Middle Creek implementation project is a successful example of Virginia's Proactive Approach to water quality improvement. The Proactive Approach aims to clean impaired water bodies through voluntary methods in order to avoid the costly and time-consuming process of developing TMDLs and TMDL implementation plans.

The Middle Creek watershed is located in Tazewell County, Virginia (Figure 5.5.1). The impaired stream segment is 11.01 miles in length and extends from its headwaters to its confluence with Clinch River in Cedar Bluff. The land area of the Middle Creek watershed is approximately 7,179 acres, with forest as the primary landuse. Approximate proportions of specific landuses as of 1995 were 96% forest, 1% agriculture, less than 1% water/wetlands, less than 1% urban/industrial development, 1% transitional, and 1% (approximately 70 acres) permitted for mining operations.

Figure 5.5.1 Middle Creek watershed



An assessment of the benthic macroinvertebrate community in Middle Creek conducted by DEQ in 1996 resulted in the stream placed on the impaired waters list for violations of the General Standard (benthics). The TMDL was scheduled to be developed beginning in 2004. Follow-up monitoring by DEQ in the spring and fall of 2003 during the initial phase of the TMDL study showed that the benthic community was no longer impaired. Instead of moving forward with TMDL development, the Virginia Department of Mines, Minerals, and Energy (DMME) and DEQ identified historical coal mining activities as the main source of the aquatic life use impairment and corrective actions that were implemented in the watershed as outlined below as the reason for the improved benthic community.

The following outline provides a history of the coal mining activities and corrective actions in Middle Creek. More information on remining and implementation activities is available in Appendix A.

- December 1981 - 200 acres disturbed Mine Lands
- 1983-1999 - best management practices required for all mines - 243.93 acres under permit
- June 1996 - DEQ biologist rates Middle Creek severely impaired
- 1999 - Last Coal Preparation Plant Idles
- August 2000 - Coal reclamation Bond Forfeiture/Reclamation Begins
- 2000 - 2002 - Reclamation Activities
 - Middle Seaboard No. 3 Mine and Greasy Creek Mine
 - De-water and remove ponds
 - Close and cover mine portal
 - Regrade and revegetate disturbed land
 - Middle Creek Energy Mine
 - Road maintenance
 - Regrade and revegetate disturbed soils
 - Remove four basins and seal groundwater monitoring well
 - Sawmill Hollow Refuse area and Fill Number 5
 - Grade and cover the refuse fill with 12 inches topsoil
 - Clean water diversions around fill area
 - Collect and dispose of chemicals on site
 - Revegetate with trees
 - Coal Preparation Plant
 - Dismantle and remove Plant
 - Coal related materials cleaned up and hauled off-site
 - Elimination of highwalls by regrading and revegetation
 - Restoration of stream channel
- June 2002 - Reclamation Complete - Cost \$400,000
- Spring and Fall 2003 - DEQ Biologist collects samples and rates Middle Creek Not Impaired

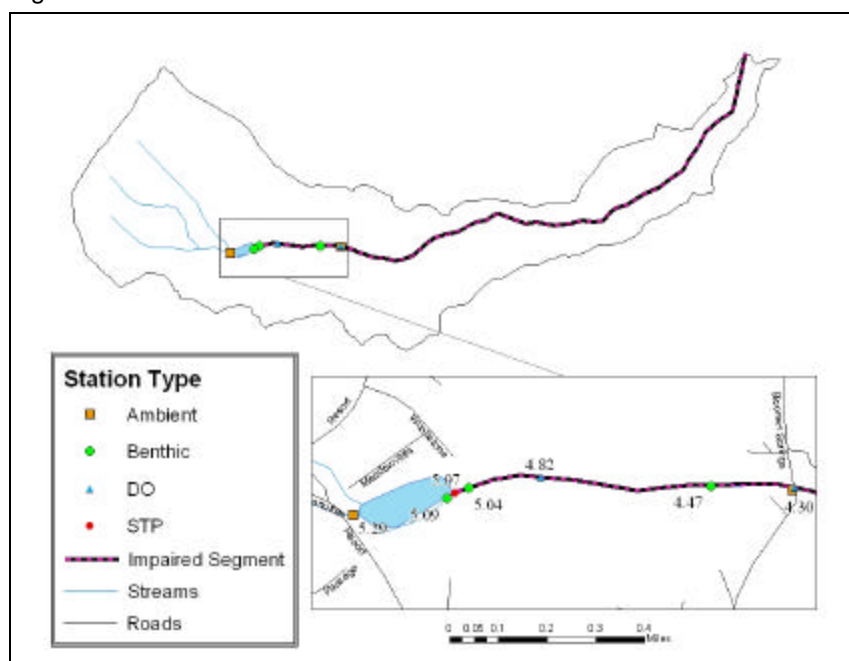
If the biological monitoring continues to show that Middle Creek is not impaired, it will be a candidate for removal from the 303d list of impaired waters.

5.6 Quail Run Watershed Implementation Case Study

Quail Run watershed is located in Rockingham County, Virginia, and is 3,513 acres in size (Figure 5.6.1). Quail Run flows east and discharges into Boones Run, which in turn discharges into the South Fork of the Shenandoah River, then the Potomac River, and finally the Chesapeake Bay.

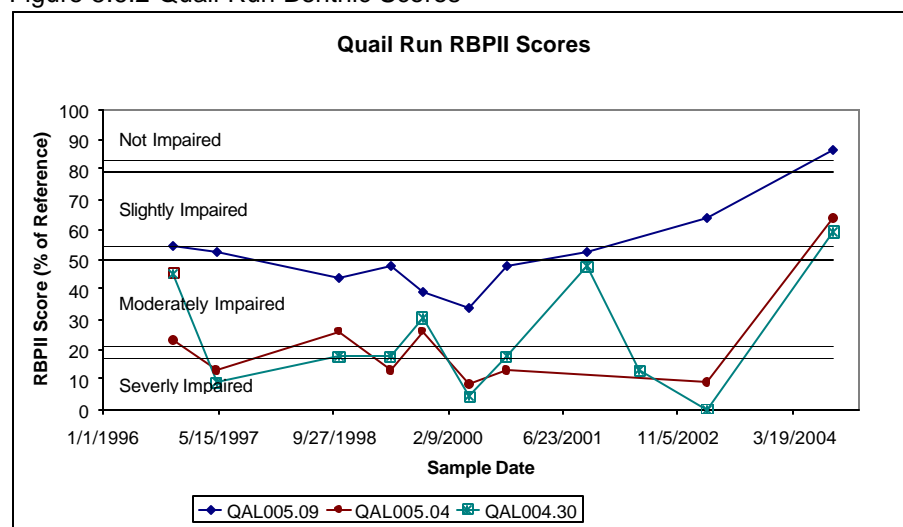
Quail Run was listed as having a general aquatic life impairment in 1998. The source of the impairment was the Massanutten STP, which had trouble meeting ammonia permit limits and used breakpoint chlorination to reduce ammonia levels. TMDLs for ammonia, residual chlorine, and chlorination by-products were developed and approved by EPA in 2003. The Massanutten STP was already under Consent Order for numerous permit violations and was in the process of designing and building a new treatment system even before the TMDL was completed. In October 2003 a portion of the new facility began operation, and breakpoint chlorination ceased. As of December 2004 the entire facility has not been completed and a Certificate to Operate the new facility has not yet been granted.

Figure 5.6.1 Quail Run watershed



The biological assessments in Quail Run were based on Rapid Bioassessment Protocol (RBP) II procedures. These follow specific guidelines in the USEPA document “Rapid Bioassessment Protocols for Use in Streams and Rivers” (Plafkin et al. 1989). Figure 5.6.2 below shows the biological assessment scores for Quail Run at three monitoring stations. Station 1BQAL005.09 is located just upstream of the Massanutten STP discharge point, station 1BQAL005.04 is located immediately downstream of the discharge, and station 1BQAL004.30 is located approximately 4000 feet below the discharge.

Figure 5.6.2 Quail Run Benthic Scores



The most recent RBPII scores (Fall 2004) are the best since DEQ has been monitoring the stream. At station 1BQAL004.30, located below the discharge, an RBPII score could not be calculated in spring 2003 because virtually no insects could be found (reported as a zero on the graph). This past fall, the site recorded a slightly impaired condition (59.09 RBPII Score).

The graph suggests that the benthic community is improving significantly at each monitoring site.

6. 2004 TMDL Program Summary and Outlook

Over the last five years, the Virginia TMDL program has successfully met the demands of a rigorous TMDL development schedule contained in the 1999 Federal Court Consent Decree. By applying the program efficiencies developed in the past few years, assuming no unforeseen new needs, and based on current estimates, future TMDL development needs can be met with level funding. However, challenges exist in the development of TMDLs for complex legacy pollutants such as PCBs and mercury, as well as in the maintenance of a growing TMDL pool with the potential for future TMDL modifications to accommodate permit needs.

A growing challenge for the program is the transition from developing TMDLs to actual water quality improvements. Because there are no new authorities for enforcing TMDLs, it has been Virginia's expectation to implement TMDLs using existing programs and funding sources. Existing programs include the DEQ's VPDES and DMME's NPDES program for permitting discharges to state waters. These programs are utilized when stream impairments are attributed to a permitted facility. For non-permitted activities, Virginia's approach has been to rely on incentive-based programs such as EPA Section 319 grant funds, the Virginia Agricultural Cost Share Program, the State Revolving Loan Fund, and USDA cost-share assistance programs, etc. These programs are available to interested citizens, land owners or local governments who want to implement BMPs to reduce non-point source inputs. Virginia has also made available dedicated 319 grant funding for BMP implementation in TMDL watersheds where an EPA-approved implementation plan was developed.

As the case studies described in this report show, there have been some success stories of water quality improvement in the three years of implementation post-TMDL development. These water quality successes have occurred not only in areas with ongoing TMDL implementation but also in areas where water quality restoration was driven by stakeholder interest or other resource management programs that preceded TMDL completion (often called the "proactive approach"). The documented water quality improvements in three implementation areas and the delisting of several streams due to water quality improvements in the surrounding watershed are encouraging signs that Virginia's streams can be restored to meet water quality goals.

To date no stream has been delisted due to TMDL implementation efforts, and the pace of BMP installation has not been as rapid as anticipated. After five years of effort under the TMDL program and evaluating the resulting impacts on water quality, certain questions arise, for example:

- Are existing programs to minimize non-permitted pollution sources enough to result in water quality improvement/attainment? How can existing regulatory programs such as the Agricultural Stewardship Act and the Virginia Department of Health regulations be better leveraged?
- What are the options for faster action/more action? What can be done to further maximize efficiencies? What innovative approaches can be tried? What funding opportunities exist?
- How can adequate funding best be obtained for agency staff and/or contractual assistance to develop implementation plans and implement BMPs?

Virginia's TMDL program has shown that properly applied and maintained BMPs do result in measurable improvements in water quality. It will be the goal of Virginia's natural resource agencies to work with the general public to take this success to the next level by successfully remediating some impaired streams within the next few years. The information provided in this report on ongoing implementation efforts will help in identifying strategies to achieve this goal and will inform stakeholders that the corrective actions that they are being asked to implement can result in water quality improvements.

Appendix A : Remining and TMDL Implementation Plans

Remining and TMDL Implementation Plans
by
George Joey O'Quinn
Virginia Department of Mines, Minerals, and Energy
November 29, 2004

The reclamation of abandoned mined lands (AML) must be part of implementation plans to restore impaired streams in Virginia's coalfields. Unfortunately for state and local planners, AML is common throughout southwestern Virginia's coalfield watersheds, AML reclamation is costly, and public AML funds are not sufficient. A variety of approaches for reclaiming AML is necessary, and Virginia's Department of Mines, Minerals, and Energy, (DMME) the state's regulatory agency for mined land reclamation, considers remining an important and appropriate method.

Virginia's receipt of primacy for the Surface Mine Control and Reclamation Act (SMCRA) established authority for a state program to control the environmental impacts of coal mining and insure the reclamation of lands disturbed by mining. Although this regulatory program, administered by DMME, is very effective in minimizing effects of current mining, a legacy of environmental problems exist. At the time the Commonwealth received SMCRA primacy in 1981, commercial coal mining had been continuously conducted in southwestern Virginia for nearly a hundred years. A century of essentially unregulated coal mining left thousands of acres of disturbed lands and miles of impacted streams. Despite efforts by DMME, local governments, watershed organizations, and planning agencies to reclaim, restore, and develop these old mines, they still cause a variety of environmental problems.

Abandoned mined lands (AML) are areas disturbed by coal mining prior to current reclamation laws and standards. AML areas occur in a variety of forms. "Shoot-and-shove" mining, a common practice in steep-slope areas prior to SMCRA, created much of Virginia's AML acreages. Soil and strata overlying the coal was blasted and pushed down hill resulting in the characteristic highwall-bench-outslope terrain still common in Virginia's coalfield counties. "Shoot-and-shove" mining created numerous environmental problems. Outslope spoils tend to be unstable and contain pyritic materials that cause acidic drainage. AML spoils are slow to revegetate, and many such areas produce sedimentation decades after they were created. Abandoned deep mines are also responsible for environmental problems. Old underground mines cause impacts such as subsidence on land

surfaces and acidic drainage from deep-mine cavities. Coal processing wastes generated at preparation plants and coal-loading sites were often disposed in a convenient hollow or creek. These old piles of refuse contribute adverse loads of sediment and dissolved minerals into the adjacent waters. Ultimately, AML features cause off-site environmental impacts including impairment of coalfield streams.

Virginia's Department of Environmental Quality (DEQ) has identified about twenty streams in southwestern Virginia as impaired by historical mining. These streams are included on the state's 303(d) list and the process of developing Total Maximum Daily Loads (TMDLs) has been initiated. TMDLs establish levels of pollution reduction necessary for stream recovery. TMDLs have already been approved by the United States Environmental Protection Agency and adopted by the State Water Control Board for several coalfield streams and development is underway for others. In all resource extraction TMDL studies, pollution loads from AML are identified as a significant contributor to the streams' impairments and load reductions, especially for sediments and dissolved solids, will be needed for the streams to be restored. The necessary pollution load reductions can only be accomplished by the reclamation of AML to current environmental standards.

The United States Office of Surface Mining Reclamation and Enforcement (OSM), using data supplied and updated by the state, maintains an inventory of AML in Virginia with the primary purpose to guide federal reclamation funding expenditures for the state. DMME administers the program funding and has successfully reclaimed many AML features in Virginia. Because SMCRA requires that federal funds expended via state programs for reclamation of AML be prioritized by potential danger to public health, safety, and general welfare, as opposed to environmental threat, OSM's inventory, as well as the state's reclamation efforts, is not necessarily focused on AML features causing the most significant environmental harm. AML areas that only impact the environment are given a lower priority. Based on the inventory as of November 1997, there are 49,558 acres of AML in Virginia with 36,375 identified as no danger to public health and safety. With few exceptions, the lower priority AML can only be addressed by OSM and the state after the high priority features are eliminated. Unfortunately, these lower priority areas are primarily responsible for coalfield stream impairments.

A viable alternative to addressing lower priority AML areas with federal reclamation funds is remining. Remining can be defined as conducting new surface coal mining operations in compliance with current environmental standards on AML areas or near AML areas where spoil from active areas may be used to reclaim the AML site. Remining can be performed on AML areas where coal

reserves were left behind. Coal companies re-disturb lands that were previously mined, remove remaining coal, eliminate existing environmental problems, and reclaim the land to current standards. DMME is actively promoting remining as a mechanism to reclaim AML that will not otherwise be addressed. DMME is also supporting remining as a principal tool for implementation plans in coalfield TMDL streams. Remining as an implementation practice will not depend on public funds, but instead on private enterprise. Remining and proper reclamation of AML features in watersheds currently impaired by AML will remove the impairment source.

Because DMME recognizes the potential for remining to address AML, as well as stream impairments, the agency facilitates Virginia's Ad-Hoc Remining Work Group. This group, formed in 1996, stimulates AML reclamation through remining. The Work Group includes representatives of the mining industry, state and federal mine-regulatory agencies, other natural resource agencies, educational institutions, and local environmental interests. The Work Group's goal is to identify potential solutions to re-mining issues and develop incentives for remining operations. The Work Group operates by consensus, with staff support and leadership provided by DMME. Several ideas have been put into practice as a result of the Work Group's efforts. These include no-cost contracts for coal companies to reclaim AML features near existing mining operations; special bonding credits for remine areas, and less stringent effluent limits for AML areas that are being remined. All incentives are designed to promote remining of AML areas.

An example of remining as an implementation practice in an impaired coalfield stream is Red River Coal Company's operations in Black Creek. Black Creek is located near the City of Norton in Wise County and the stream was placed on the state's 303(d) list in 1998. Macroinvertebrate data collected by Dr. Donald Cherry of Virginia Tech determined that the benthic health of the stream was severely impaired by acid mine drainage (AMD) from old deep mines in the watershed. A TMDL study of Black Creek was completed in 2002. The TMDL study determined that the specific chemical stressors causing the benthic impairment were total manganese and dissolved solids and that these stressors are related to the AMD. Red River Coal Company's approved mining and reclamation plans directly address the stressors.

Red River Coal Company is a local coal company currently remining in the Black Creek watershed. Operations plans include reclamation measures specifically designed to address the stream's impairment source; elimination of a large underground mine area via daylighting – uncovering the mine voids and purging the acidic waters; and the reclamation of about 300 acres of AML. Incentives incorporated in the mining plans are alternate and less stringent effluent limits. The

reclamation measures should reduce the stressors identified in the TMDL study. At present, the remining operation is seventy-five percent complete and initial environmental results are very positive. Chemical water monitoring performed routinely in Black Creek by the coal company shows marked improvement and macroinvertebrate data collected under a DMME contract in 2003 already shows better aquatic insect population. After remining and reclamation is complete, DMME and DEQ will reassess the impairment status of the stream and, hopefully, be able to remove Black Creek from the 303(d) list.

In 1998, PA DEP developed a remining database to determine the success of Pennsylvania's remining program in terms of water quality and the extent to which remining reduced pollution loads from pre-existing sites. Evaluations were made by comparing pre-mining and post-mining loads at individual discharges for several parameters and the results broken down by stressor or pollutant. The state reviewed over two hundred remining operations. The best management practices utilized – daylighting deep mines, regrading, revegetation, and alkaline addition - are common to remining operations in Virginia and are being used by Red River Coal Company at their Black Creek surface mine. For example, the results show that for those sites that reduced the level of manganese, the average reduction was 70%. The average load reduction for acidity for all sites was 61%. When compared to stressor reductions observed with the remining processes in Pennsylvania, the recommended reductions for Black Creek appear attainable.

The reclamation of AML areas in southwestern Virginia's coalfields will be a critical component of watershed restoration and implementation plans for streams impaired by historical coal mining. Because the cost of that reclamation work will be tens of millions of dollars, the current federal AML program funding will not be able to address the problems effectively. Another approach is needed and remining is a viable alternative that involves stakeholder interests and private funds. Initial efforts appear to be working well and DMME will continue to encourage remining of AML in other impaired watersheds.